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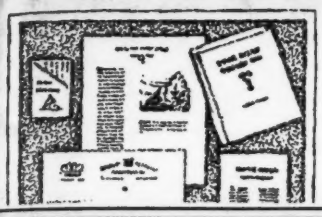

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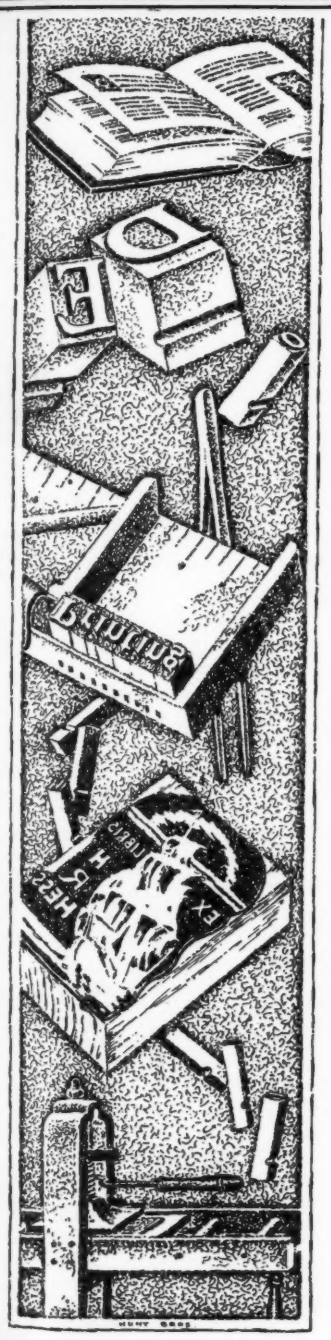

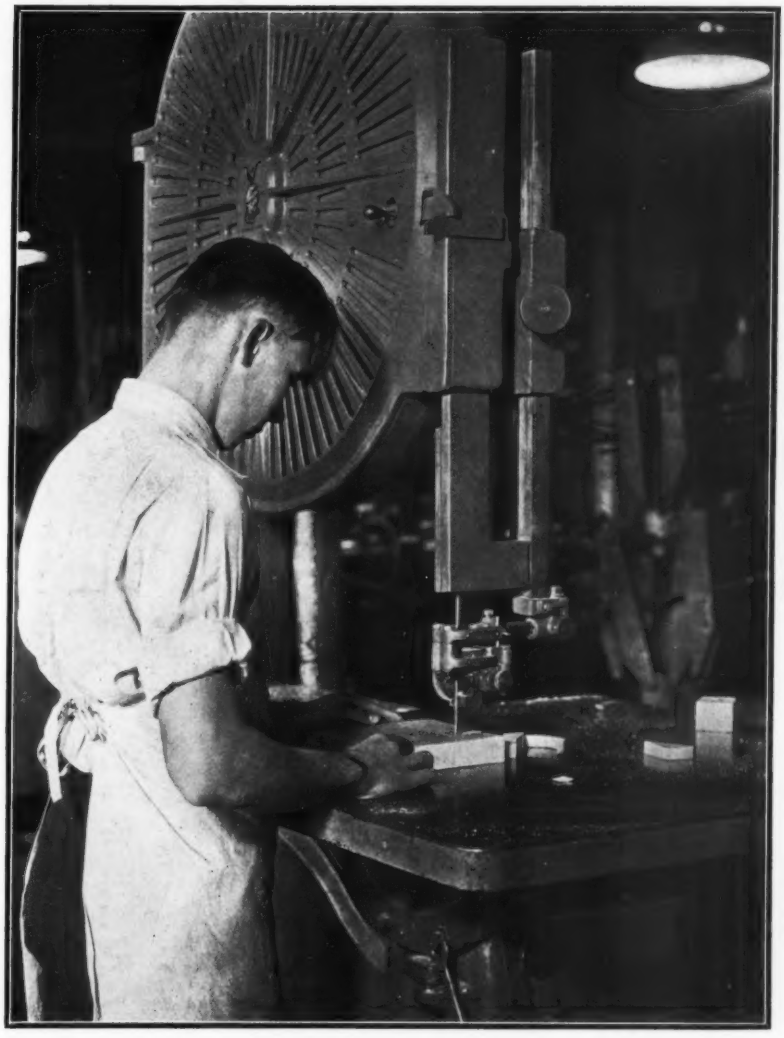

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INDUSTRIAL ARTS and VOCATIONAL EDUCATION
September, 1934
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Individual Instruction Sheets

Richard M. Carlsen

Detroit, Michigan

This is a comparison of the accomplishment of classes in mechanical drawing using individual instruction sheets with classes not using individual instruction sheets.

UNDER a system of mass instruction, especially when the classes are large, it is difficult for the teacher to give much attention to individual pupils. The assignments, questions, explanations, or the instructional procedures are planned for the average pupil. The conscientious teacher probably always has made some effort to *help* backward pupils, and since individual differences have been emphasized, several fairly well defined procedures have been devised to provide for the mentally superior child, as well as for the one who is below average. The general types of adaptation of instruction to individual differences are well known, but in practice there are many variations.

The dire need of some form of individual instruction sheets was first brought to the attention of the writer when teaching mechanical drawing in the Cleveland Intermediate School in Detroit. A class of about forty boys would come in for instruction. This group might include boys who had come from parochial, country, and public schools where very little or no drawing had been taught. Also, boys who had started out taking a commercial or general language course in the 8B grade and then had decided to change their course in the 9B grade might be found in these same classes. Consequently many of the members in the class would have missed prerequisite courses. As a result, two, three, and often four different levels of work would have to be taught in the same class. Such a condition naturally drives the teacher to seek some means to meet the various needs present in a group.

Although Detroit uses *ability grouping* as a means of securing homogeneous classes, given sections in drawing show a great variety in ability. The reason is not hard to find. The pupils are grouped homogeneously for purposes of homeroom classification. This would seem to provide an opportunity to group the students according to *ability* for academic classes. In the 8B and 9B grades several curriculums are offered, however, and due to the uneven choice of courses, the problem of keeping the classes in shop, drawing, cooking, music, and art balanced without changing the homeroom grouping is very difficult. The best that can be done is to schedule the boys from several rooms to take drawing together.

The net results of this sort of grouping demanded individualized group instruction in mechanical drawing. Under traditional procedures instruction given to such classes could at best be the instruction of the component small groups. In the experience of the writer this method proved not at all satisfactory because each of these small groups were themselves anything but homogeneous. Then, too, a boy in the 9A class doing 8B work progresses faster than a boy in the 8B doing the same work.

This situation caused the author to write individualized instructional material for the boys to use. For five years these instruction sheets were used in the classroom and proved a suggestive procedure for taking care of such large, heterogeneous classes. Consequently, at the beginning of the study, of which this is a report, the writer improved and revised many of the instruction sheets, supplemented them with others which were here used for the first time, and subjected the whole procedure which he had evolved to the trial of a control experiment.

The value of individual instruction sheets in the field of mechanical drawing has never been objectively ascertained so far as the present investigator has been able to determine. This paper aims to report an objective comparison of the accomplishments of a group of 8A boys using individual instruction sheets with a group taught without the use of individual instruction sheets, and to list the subjective reactions of the teachers using the individualized instruction sheets in their classes.

A rough matching technique was used to eliminate the effects of as many of the variable factors as possible. The experimental and control groups were first matched with respect to these factors:

a) Socio-economic status.
b) School experience.
c) Equipment and supplies.

The socio-economic status must be taken into consideration when comparing the achievement of two groups. Consequently schools were selected that were situated in about the same type of surroundings. That is, the schools used in this study drew boys and girls from about the same type of homes, their parents worked in general at the same type of work, and the general intelligence of the students was about the same.

School experience means the amount and quality of the pupil's educational history. The boys were all in the 8A grade and only those who had completed the prerequisite courses given in the 8B were selected. All boys were taking the practical-arts course given in the intermediate school and, therefore, had the same amount, and roughly the same quality of instruction.

The equipment and supplies for mechanical drawing are standardized in all Detroit intermediate schools.

The Detroit mechanical-drawing test, like most tests, requires the ability to read. The reading ability of two groups to be compared in skills other than reading must necessarily be as near the same as possible if the comparison is to be valid. The reading ability of the experimental and control groups was measured by the Detroit reading test 4. The results indicate that the reading ability of the two groups was about the same. The mean for the experimental group was 6.8, while

the mean for the control group was 7.0. The S.D.[1] of the experimental group was 12.7 while the S.D. of the control group was 15.1.

For the experimental group the following schools in Detroit were selected: Neinas Intermediate, Burroughs Intermediate, and Hutchins Intermediate; for the control group, Tappan Intermediate, Cleveland Intermediate, and Durfee Intermediate.

Boys in the experimental group were also matched with boys in the control group with respect to: (*a*) grade; (*b*) age; (*c*) brightness.

The experimental and control groups were both composed of 8A classes, thus holding grade constant for both groups.

The boys were divided into three equal groups according to age. For the purpose of this experiment the oldest one third was considered as over-age, the middle one third as at-age, and the youngest one third as under-age.

The classes compared were composed of boys, thus holding sex constant for both groups.

The boys were classified into three different intelligence groups according to the letter ratings secured from the school office records. Detroit uses seven letter ratings to indicate degrees of intelligence. The boys whose letter rating was A or B were grouped together and classified as *bright*, those whose letter rating was C+, C, or C— were grouped together and classified as *average*, and those whose letter rating was D or E were grouped together and classified as *dull*.

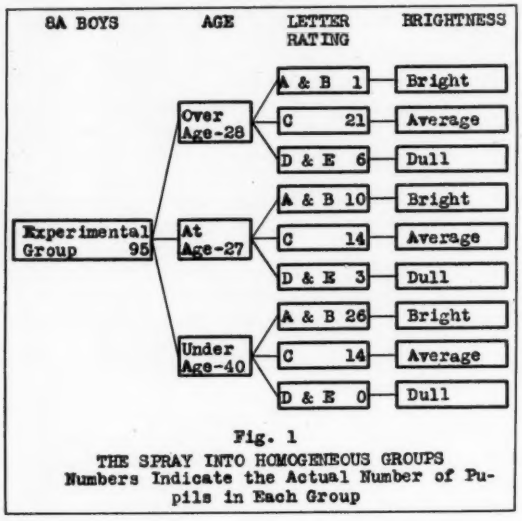

Fig. 1
THE SPRAY INTO HOMOGENEOUS GROUPS
Numbers Indicate the Actual Number of Pupils in Each Group

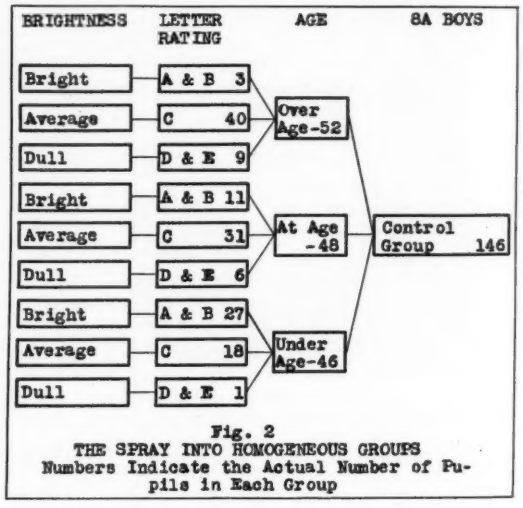

Fig. 2
THE SPRAY INTO HOMOGENEOUS GROUPS
Numbers Indicate the Actual Number of Pupils in Each Group

The boys were matched into groups which were homogeneous with respect to grade, age, and brightness (see Figures 1 and 2). This grouping resulted, theoretically, in nine homogeneous experimental and control groups. Comparison between the achievement of these homogeneous subgroups would be legitimate as a measure of the growth in mechanical drawing.

The distinguishing factor in the teaching of the experimental group is the use of individualized lesson sheets. The control group was taught by the conventional form of instruction, but without lesson sheets.

Each boy in the experimental group was given a set of mimeographed sheets containing the assignments, information sheets, and job sheets at the beginning of the term. This was the boys' property to use in or out of school. The drawing problems were assigned from the "Mechanical Drawing Lesson Sheets One," for intermediate and high schools published by the Board of Education, city of Detroit. The general and related information was taught to the experimental group as a class, but each individual boy could progress as rapidly as he was able to do the drawing of the problems. Some of the boys in the experimental group needed little help in solving the problems other than that given in the lesson sheets.

The control group was given the same assignments as the experimental group, but they did not have the set of mimeographed sheets. If a boy in the control group was absent when a new problem was presented, he had to get help from another student or the teacher in contrast to the boys in the experimental group who could, if they were willing, master the lesson themselves by reading the assignments given in their lesson sheets.

Authors disagree in their terminology of written instruction sheets. R. W. Selvidge[2] has analyzed the instruction sheet as follows:

The instruction sheets that tell how to perform manipulative operations are called operation sheets.

Instruction sheets that deal with items of information are called information sheets.

Instruction sheets, composed largely of questions designed to direct observation, reading, and drill, are called assignment sheets.

Instruction sheets that tell how to do complete jobs which may involve a number of operations are called job sheets.

The author did not write any operation sheets for use in this experiment because each boy has Mr. F. R. Kepler's *Mechanical Drafting Handbook*[3] in which the use and care of instruments is well written.

Three strictly information sheets were written and used in this experiment. The first was on the "third angle of projection," the second is on "screw threads," and the third is on "exceptions to true projection." There were certain definite items of information that the student was expected to get and the instruction was centered around these points. The students studied the information sheets before making a drawing requiring a knowledge of the things explained in the information sheets.

Nine assignment sheets were written. These sheets were designed to make possible differentiation of assignments. The boys working for an A grade were assigned the most difficult drawing, those working for a B the next most difficult drawing, and those working for a C the easiest drawing. Several references were listed which all of the boys might use, but were principally designed for the boys selecting the B and A levels of work. The boys chose the levels they wished to undertake,

[1] S.D. = Standard Deviation.

[2] Selvidge, R. W., Individual Instruction Sheets, Manual Arts Press, Peoria, Ill.

[3] F. R. Kepler, *Mechanical Drafting Handbook* (Milwaukee: Bruce Publishing Co., 1928).

with, of course, some help or advice in this matter from the teacher. On this same sheet appraisal questions were written for each unit of work. The author's object in writing these questions was to enable the boys to complete a partial check upon their own drawings before submitting them to the instructor for his approval.

Several general questions followed the appraisal questions and were to be answered by all the boys regardless of the level of work they chose. The purpose of these questions was to definitely clinch, so to speak, the new points of that lesson.

Eight job sheets were written. The job sheet gives instructions for doing a specific and complete job, such as "To make a mechanical drawing of the Hex Bar." Job sheets were written only for the C level of work.

The criteria selected as bases for comparison were two, the first objective and the second subjective. Objective criterion, pupils' growth in knowledge of mechanical drawing as measured by the Detroit mechanical-drawing test; subjective criterion, the reactions of the instructors who helped to carry out the experiment.

The objective data was secured by giving the Detroit mechanical-drawing test, parts one and two. The test was given to the experimental and control groups by the classroom teacher the first week in September when the classes convened. The tests were corrected by each class. Then all the tests were collected and rechecked by a different group of boys who had been trained in scoring the tests. At the end of the semester the same test was given and scored as before.

The subjective data was secured by sending a questionnaire to the teachers teaching the experimental group to obtain their reactions, irrespective of the objective results obtained.

The growth of knowledge of the experimental group and the control group will be expressed in units of raw score and standard deviation. There were 95 cases in the experimental group and 146 cases in the control group. In all comparisons the scores of the control groups were adjusted so that they would represent scores of groups equal in size to the experimental groups.

Figure 3 shows a comparison of all *over-age* groups based on brightness. You will notice that the bright and dull control groups make a larger mean gain than the corresponding experimental groups, but the number of cases in these two groups are so few that little consequence can be placed in their comparison. These control subgroups are the only two that had a larger mean gain than the experimental subgroups. The *average* group has more cases and in this comparison the experimental group made a substantial mean gain of 4.8 points.

Figure 4 shows a comparison of all *at-age* groups based on brightness. You will notice that the *dull* experimental group made a mean gain of 33.2 points over the control group. Little emphasis can be placed on this comparison due to the small number of cases. Again, the *average* group made a substantial mean gain of 6.9 points while the *bright* group made a slight mean gain of .4 of a point.

Figure 5 shows a comparison of all *under-age* groups based on brightness. The *bright* group made a gain of 8.6 points over the control group while the *average* group made a 1.9 gain.

Figure 6 shows a comparison of all the bright, average, and dull pupils regardless of age. The experimental groups in every case made a larger mean gain than did the control groups. The experimental *bright* group made a mean gain of 35.1, the control group 28.9, a difference of a mean gain of 6.2 in favor of the experimental group. The experimental *average* group made a mean gain of 30.4, the control group 25.9, a difference of a mean gain of 4.5 in favor of the experimental group. The experimental *dull* group made a mean gain of 27.9, and the control group 21.1, a difference of mean gain of 6.8 in favor of the experimental group.

Figure 7 shows a comparison of all the *over-age*, *at-age*, and *under-age* pupils regardless of brightness. Again, the experimental groups show a decided mean gain over the corresponding control groups. The experimental *over-age* group made a mean gain of 28.3, the control group 27.2, a difference of mean gain of 1.1 in favor of the experimental group. The experimental *at-age* group made a mean gain of 32.2, the control group 24.8, a difference of mean gain of 7.4 in favor of the experimental group. The experimental *under-age* group made a mean gain of 34.4, the control group 28.1, a difference of mean gain of 6.3 in favor of the experimental group.

The reliability of the obtained difference in terms of

Comparison of Over-age Groups Based on Brightness					
	No. of Cases		Mean Gain		Difference Mean Gain
	Groups		Groups		
	A	B	A	B	A - B
Bright	1	3	16	17.7	-1.7
Average	21	40	32.3	27.5	4.8
Dull	6	9	16.5	22.9	-6.4

Note: Group A is the experimental group which used written instructions. Group B is the control group which did not use written instruction sheets.

Fig. 3

Comparison of At-Age Groups Based on Brightness					
	No. of Cases		Mean Gain		Difference Mean Gain
	Groups		Groups		
	A	B	A	B	A - B
Bright	10	11	31.9	31.5	.4
Average	14	31	28.4	21.5	6.9
Dull	3	6	50.7	17.5	33.2

Fig. 4

Comparison of Under-Age Groups Based on Brightness					
	No. of Cases		Mean Gain		Difference Mean Gain
	Groups		Groups		
	A	B	A	B	A - B
Bright	26	27	37.0	38.4	8.6
Average	14	18	29.7	27.8	1.9
Dull	0	1	....	....	

Fig. 5

Comparison of All-Bright, Average, and Dull Pupils Regardless of Age					
	No. of Cases		Mean Gain		Difference Mean Gain
	Groups		Groups		
	A	B	A	B	A - B
Bright	37	41	35.1	28.9	6.2
Average	49	89	30.4	25.9	4.5
Dull	9	16	27.9	21.1	6.8

Fig. 6

Comparison of All "Over-Age", "At-age", and "Under-age" Pupils Regardless of Brightness					
	No. of Cases		Mean Gain		Difference Mean Gain
	Groups		Groups		
	A	B	A	B	A - B
Over-age	28	52	28.3	27.2	1.1
At-age	27	48	32.2	24.8	7.4
Under-age	40	46	34.4	28.1	6.3

Fig. 7

"chances that the obtained difference represents a true difference greater than zero" is shown in Figure 8.

The S.D. of the difference, 1.57, of the total bright groups indicate that 94 chances in a 100 the true difference is greater than zero in favor of the experimental group; the S.D. 1.28, of the total average groups, 90 chances in a 100; the S.D. .57, of the total dull groups, 72 chances in a 100.

Reliability of the Obtained Difference

Total Group	S.D. of Difference	The probability that the true difference between the measures of Groups A and B is greater than zero.[1]
Bright	1.57	94 chances in 100
Average	1.28	90 chances in 100
Dull	.57	72 chances in 100
Under-age	1.77	96 chances in 100
At-age	1.35	91 chances in 100
Average	.22	58 chances in 100

[1] H. E. Garret, "Statistics in Psychology and Education," pp. 91-134-141. New York: Longmans Green and Co., 1926.

Fig. 8

Comparison of Total Experimental and Control Groups

No. of Cases		Mean Gain		Difference Mean Gain
Groups		Groups		
A	B	A	B	A - B
95	146	32	26.6	5.4

Significance of Difference: 2.05

The probability that the true difference between the measures of Groups A and B is greater than zero is 98 chances in 100.

Fig. 9

The S.D. of the difference, 1.77, of the total *under-age* groups, indicate that 96 chances in 100 the true difference is greater than zero in favor of the experimental group; the S.D. 1.35, of the total *at-age* groups, 91 chances in a 100; the S.D. 22 of the total *over-age* groups, 58 chances in a 100.

The S.D. of the differences may also be interpreted as meaning that the experimental *bright, average, under-age,* and *at-age* groups show a possible difference in achievement over the control groups. The *over-age* and *dull* groups indicate no difference.

Figure 9 shows a comparison of the total experimental and control groups based on the points gained on the Detroit mechanical-drawing tests. The mean gain of the experimental group was 32.0 in contrast to 26.6, that of the control group. Therefore, the total experimental groups showed a mean gain of 5.4 over the control group. The S.D. of the difference, 2.05, can be interpreted as meaning that in 98 chances out of 100 the true difference is greater than zero, or that there is a probable difference in the achievement of the total experimental group over the total control group.

The significance of the 5.4 mean gain made by the experimental group in terms of school success is also interesting. The city median for the 8B and 8A grades on the Detroit mechanical-drawing tests was 68.0 and the city median for the 9B and 9A was 74.1. The median gain for one year's work would therefore be 6.1 points. In this experiment the mean gain for the experimental group over the control group was 5.4. Therefore, comparing these two figures, we might draw the conclusion that the experimental group made almost a year's growth in the knowledge of mechanical drawing more than the control group. The city medians, however, for the 8B and 8A grades and 9B and 9A grades are not reliable enough to insure the validity of this conclusion. It indicates, however, that there is a school gain which is of some significance.

In this experiment, the bright and under-age groups received the most help from the written instructions, and the average and at-age groups received more help than the dull and over-age groups.

The following subjective conclusions were drawn from the questionnaire sent out to the teachers teaching the experimental groups. Conclusions were drawn from only those questions answered unanimously "yes" or "no." They may, therefore, be looked upon as having some significance; first, the instruction sheets enlarged and extended the amount of help the instructor was able to give each individual boy; second, job sheets, giving detailed information for making a particular drawing, are of value to the average boy; third, the students doing A and B work grew in their ability to plan their jobs and in their willingness to assume responsibility for their work; fourth, the use of written instruction sheets does not put an additional burden on the teacher; fifth, job sheets do not give too much help to the boys doing the C assignments; sixth, written instructions help the students organize their work; seventh, written instructions tend to develop a feeling of self-reliance on the part of the student; eighth, students in the intermediate-school drawing classes have difficulty in getting information from the printed page; ninth, the majority of the students like written instructions.

The objective and subjective conclusions drawn seem to indicate that individual instruction sheets are of value in teaching mechanical drawing.

Visual Aids in Safety Education

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An opportune article on the subject of safety. It is taken from an address made by the author at the 1933 Annual Greater New York Safety Conference of the National Safety Council.

THIS article lays special emphasis on those aids which are of particular value to the teacher of industrial and vocational classes. Most of those mentioned can be acquired or made with little difficulty and expense. Some of them may be made by the shop students.

The term "visual aids" may be considered as such teaching devices which are primarily based on the sense of vision for their effectiveness. They include motion pictures, lantern slides, posters, charts, photographs, cartoons, and dramatic presentations.

That these visual aids for the teaching of safety have value, is demonstrated by the fact that industry, which is largely interested in the economic value of a method, has so wholeheartedly adopted them in its safety campaigns. Thousands of safety posters are in daily use in practically every industry. A number of motion-picture films have been made solely for the purpose of teaching safety to the employees in industrial plants. In addition many factories have set up safety museums where safety devices are shown and demonstrated. Strange to

say, however, the schools, for the most part, have been slow to follow in the footsteps of industry in attempting to teach this most vital subject. Shop teachers in general have depended upon a few general talks on safety, and on a few posters, which after being placed on the shop walls are promptly forgotten, for teaching safety.

It is true, the most effective way of teaching safety in the school shops is actually practicing safety when using tools, machines, and equipment in the shop, yet it is difficult at times to show the proper safety precautions on certain machines to an entire class. This may be due to the fact that it is difficult to demonstrate some phases of safety in such a manner that the teacher can be sure that each member of the group can see exactly what is being shown. Another difficulty in demonstrating on the machine is the fact that it is usually impossible to show what may happen if the safety precautions are not followed. Of course, psychologists tell us that it is not good practice to show the wrong way of doing things. Yet many times this is the most effective method to use, particularly in teaching such a subject as safety, where it is imperative that the student be not permitted to experiment with the wrong method. Most psychologists, however, do not entirely disapprove of this method provided the correct procedure is first shown. With this attitude there can be no quarrel.

Again, in demonstrating safety precautions, it is frequently necessary to have machinery in operation. This makes it difficult for the class or group to hear what is said by the instructor. The group is also highly interested in watching the machine in operation with the result that they do not get the full benefit of what is said. Also, many safety devices on machines are in such positions that it is hard even for one individual to see them, and practically impossible to show them to a group. These are but some of the difficulties which arise in attempting to teach the safe use of machines by actual demonstration.

By the use of visual aids, many of these difficulties can be circumvented, and safety instruction be made more effective. Lantern slides or charts presenting various safety precautions and devices can be so shown that each member of the group can readily see what the teacher wants him to see. By the same means, the result of neglecting to use the safety devices or heed the safety precautions can be shown without endangering persons or machines. The use of these visual aids is not accompanied by distracting noises which may prevent some from hearing, nor do they cause the class to become distracted by the actual motion of the machine. With the visual aids, the attention of the class can be definitely focused on what is being discussed. Also, through the use of visual aids, even the safety devices and hidden dangers which it is extremely difficult to show a group can be clearly portrayed.

Perhaps a concrete example as to how visual aids may be used in teaching the safe use of a circular saw will be helpful. In taking up the idea of safety in connection with this machine, probably the first step should be to state its use and its dangers. This might be followed with an actual demonstration of ordinary crosscutting and ripping, with such precautionary talk as is necessary. After this, such visual aids as lantern slides or charts showing the precautions to observe in setting the rip fence, the use of the rip guard, the splitter, the height of the saw blade, the use of a follow-through stick on small work, the positions of a person for various operations, and other things of this nature might well be shown.

The use of these visual aids might be followed by others showing the result of neglecting these precautions, such as binding due to a slipping rip fence, the danger of a guard which is out of alignment, accidents due to standing in line of the saw while ripping stock, or not using a follow-through stick, and other things of this type.

Many of the visual aids or slides and charts just mentioned can be made by the teacher and by the pupils. Ground-glass slides can be made by any person with the ability to draw or trace. They may be drawn or traced in pencil, India ink, water colors, or colored crayons. Through the use of color, such as red, it is easily possible to emphasize the safety precautions or dangerous places on a machine. With only slightly more difficulty, photographic slides of safety operations may be made. In this way it is easy for each instructor to make up slides and charts which will definitely work in with his teaching plan.

It also should be remembered that the making of these charts will arouse much interest among the pupils, and much rivalry can be injected as to who can make the most effective slide or chart. The use of these pupil-made aids is bound to increase the attention of the class and thus make it possible to have real, live lessons.

Another effective visual aid for use in the school shop is the poster depicting the correct method of using tools and equipment. Such posters may show the proper manner of carrying sharp-edged tools, the need of removing nails before discarding a board, etc., also the results of not observing these precautions. However, it should not be expected that such posters, excellent as they may be, will suffice to teach safety without the teacher's help. Posters can perhaps be most effectively used by briefly discussing them with the class and then posting them on the bulletin board for a period of a week or two. They should then be replaced by others and perhaps used again later. This is to prevent them from becoming a dead issue with the pupils, which is apt to happen with any poster or chart kept before a class too long.

The number of posters used at one time should also be limited. It is much better to thoroughly discuss one or two at a time with the class than to use a large number indiscriminately. The teacher should note how often the posters on safety are changed on street cars and on billboards. This is done to keep them effective.

While it is possible to make safety posters in the shop, there also are many of these aids that can be purchased. Such posters are distributed by the Elliott Service Company of New York, and the National Safety Council of Chicago. They may be obtained at small cost, are usually more effective and show the point more clearly than could ordinarily be done in the shop.

The dramatic sketch is another visual aid which may be used to advantage by the schools. In such a sketch, the various characters vividly portray safety in many forms, and also the result of neglecting safety precautions. The sketch is particularly effective in the lower grades and will arouse much interest.

The motion picture is a very effective aid in teaching safety, and although its use has been rather limited, yet it is becoming increasingly more popular. There are a number of these films available at present which can be obtained with little or no cost to the schools. These films do not necessarily have to deal only with safety, however, as many industrial films show not only the safety methods used in industry, but other information as well. Motion pictures dealing with the various aspects of safety in the school shops also can be made by the schools on 16-mm. film. Such films will stimulate much interest and enthusiasm in safety education both in their taking and showing. Films of this type have been successfully used by a number of progressive schools.

While the school is primarily concerned with safety education in the school shop, nevertheless, the shop instructor should also be concerned with safety methods used in industry. This, too, can be accomplished by using motion pictures. With the aid of slow-motion-picture photography, many safety devices which normally operate quicker than the eye, can be clearly shown. Then, too, most operations in industry are performed on machines running on a production basis, and where speed is an important factor. This requires different types of safety devices from those used on the machines in the school shop where speed and quantity production are not the primary aim.

Class trips to various industrial plants, museums of safety, and similar places, are also outstanding visual aids which can

be effectively used in connection with safety education in relation to industrial and vocational classes. Many of these plants employ safety engineers whose function it is to educate the employees in the value of safety and safe working conditions. These men will be glad to give the students first-hand information about safety work as it is conducted in industry.

Visits to safety museums in those cities in which they are operated will acquaint the students with many types of safety devices as well as with numerous charts, pictures, posters, films, and slides dealing with safety. A visit to such a museum might well be required of all pupils in vocational classes.

Since safety education is such a vital part of school-shop instruction, it should receive a great deal more attention from shop teachers than it has in the past. Furthermore, much of the safety education, as now taught, is obsolete both in method and content and should be improved by establishing closer coöperation between the schools, industry, and the various safety organizations. Finally, much of the safety education in the school shop can be taught most effectively through the use of visual aids such as charts, slides, posters and motion pictures, and all of these methods should be made available and used in the safety instruction in the school shop.

Junior-High-School Drawing

Harry W. Stevens

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This study was made with a view of finding what type of drawing is being taught in the junior high school, and what changes ought to be made in the courses offered in order to bring the offerings of the subject matter more nearly in accordance with the modern objectives for that subject in the junior high school.

THERE is considerable disagreement among supervisors and teachers of mechanical drawing in the junior high school regarding the content of their courses of study. Some of these teachers believe that it is desirable to teach one phase of drawing thoroughly, while others favor a more general program.

A survey of commonly used drawing tests and courses of study indicates that the drawing content in the past has been quite definitely limited in scope. In view of this disagreement, the writer made a survey to determine the drawing content which best fits the needs of the junior-high-school student.

For this purpose, information was gathered from the following sources: drawing textbooks of junior-high-school level — 15; magazine articles (general) 12; city courses of study (cities over 300,000) — 9; advanced drawing texts — 6; tests on drawing — 5; textbooks on junior-high-school curriculum building — 5; vocational annuals — 3.

From this information a check sheet was prepared and submitted to a jury of 100 selected men composed of assistant superintendents of vocational education, directors of industrial education, supervisors of drawing, junior-high-school principals, authors of drawing texts, and teachers of drawing. In addition, 145 ninth-grade boys, and 56 of the fathers of these students, coöperated in proportioning the percentage of time to be devoted to various drawing phases which they thought best fitted to the needs of the junior-high-school student.

	At time of Study	Teachers	Parents	Students	Average of Teachers, Parents, Students
Machine	54.2	40.5	37.5	39.2	39.1
Architectural	9.8	18.2	21.3	20.8	20.1
Charts, Graphs Maps, Diagrams	4.2	9.8	11.6	10.9	10.8
Sheet Metal	12.5	12.2	10.1	10.2	10.8
Furniture	15.2	11.1	9.8	8.6	9.8
Electrical	4.1	8.2	9.7	10.2	9.4

Table I. Percentage of time now devoted to six phases of drawing in the junior high school. Also the recommendations for changes in the present apportionment of time

Table I shows the percentage of time devoted to six phases of drawing in the junior high school at the time the survey was made. It also shows how teachers, parents, and ninth-grade students would apportion the time devoted to these six

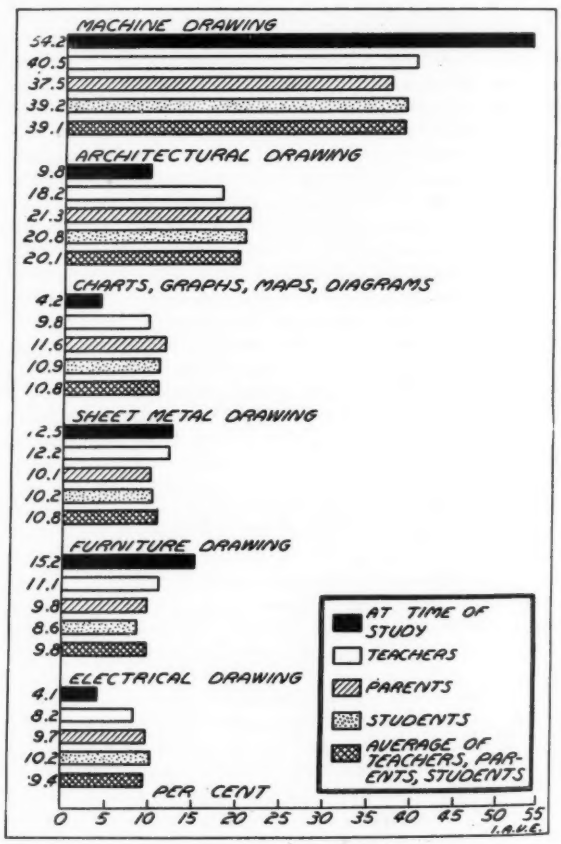

Fig. 1. Diagram showing percentage of time now devoted to six phases of drawing in the junior high school. Also the recommendations for changes in the present apportionment of time

	At time of Study	Teachers	Parents	Students	Average of Teachers, Parents, Students
Free-hand Drawing	21.8	34.4	37.5	35.1	35.7
Instrumental Drawing	78.2	65.6	62.5	64.9	64.3

Table II. Percentage of time now devoted to free-hand sketching and instrumental drawing in the junior high school. Also the recommendations for changes in the present apportionment of time

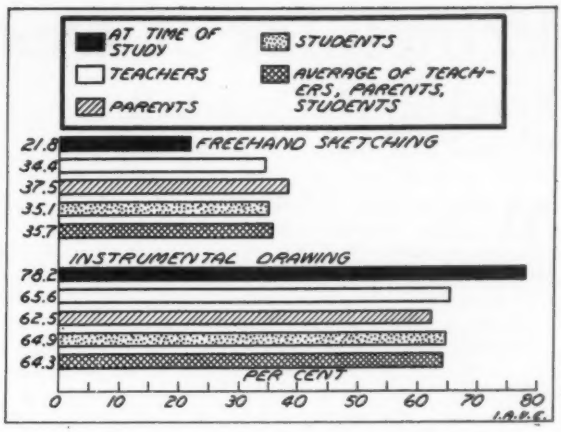

Fig. 2. Diagram showing percentage of time now devoted to free-hand sketching and instrumental drawing in the junior high school. Also the recommendations for changes in the present apportionment of time

phases. In Figure I, this information is depicted in diagram form.

Table II shows the proportion of time given to free-hand sketching as compared to instrumental drawing. This information is diagrammatically shown in Figure 2.

From these tables and diagrams, it is apparent that mechanical drawing is being taught from a much too highly specialized point of view in the junior high school. In a number of the cases examined, the mechanical-drawing course consisted almost entirely of machine drawing. The choices indicated by teachers, parents, and students show a desire to make the drawing in the junior high school much more exploratory in nature. In other words, they indicate that courses should consist of general mechanical drawing covering various phases and including free-hand sketching so that the student is given a greater opportunity to discover his interests, aptitudes, and capacities.

Figure 2 also shows that free-hand sketching should receive more attention than is now accorded to it.

The following list of items selected by 65 teachers, supervisors, and directors of mechanical drawing and industrial education, represents those which the boy should know and be able to do at the close of the junior-high-school period.

Things the Boy Should Be Able To Do at the Close of the Junior-High-School Period

1. Select, care for, and use drawing equipment.
2. Select, sharpen, and use appropriate pencil.
3. Be able to letter, using an alphabet of inclined letters.
4. Use the conventional alphabet of lines.
5. Fasten paper to board and lay out border and titles.
6. Select best views to be drawn and balance them on the sheet.
7. Make drawings full size and to scale.
8. Use handbooks, catalogs, and references and data sheets.
9. Pencil drawings in correct order of procedure.
10. Ink drawings in correct order of procedure.
11. Make orthographic and pictorial drawings from simple models.
12. Read working drawings made in third-angle projection.
13. Make simple detail drawings of machine parts.
14. Measure model objects with steel rule and calipers.
15. Make notations as to drilled, reamed, and tapped holes.
16. Draw simple sections: full, half, partial.
17. Represent conventional threads, internal and external.
18. Show conventional breaks: round, square, rectangular.
19. Construct hexagon, octagon, and ellipse.
20. Use abbreviations, such as dia., rad., hex., oct., sq.
21. Make simple perspective free-hand sketches.
22. Make preliminary orthographic free-hand sketches.
23. Dimension orthographic instrument and free-hand drawings.
24. Make instrumental perspective and isometric drawings.
25. Know types of drawings: perspective, isometric, orthographic.
26. Conventional representation of metal, wood, brick, concrete.
27. Sketch floor plans and elevations of cabin, garage, cottage.
28. Make simple floor plans and elevations with instruments.
29. Make tracings in pencil on paper of the "vellum" type.
30. Reproduce drawings by blue-printing.
31. Make surface developments of cube, cylinder, cone, pyramid.
32. Lay out, cut, and form simple developments from stiff paper.
33. Make orthographic drawings of simple pieces of furniture.
34. Make free-hand assembly sketch of simple machine units.
35. Make a bill of materials for small table or stool.
36. Make details of simple joints as miter, doweled, and butt.
37. Use electrical symbols for battery, motor, bell, switch, lamp.
38. Draw electrical bell circuits free-hand.
39. Make charts, graphs, and diagrams to show trends and facts.
40. Check all drawings for measurements, contrasts of lines, notations, dimensions, lettering, proper views, and balance.

Related Information the Boy Should Know at the Close of the Junior-High-School Period

1. How to safeguard sight and general health in drafting room.
2. Draftsman's working conditions, wages, hours, opportunities.
3. How to make application for a job.
4. The contribution that drawing has made to civilization.
5. The divisions of drafting and occupations related to each.
6. Books, periodicals, and societies related to drawing.
7. Characteristics of pencils, erasers, ink, and paper.
8. Qualification of draftsman: physical, artistic, educational.
9. Advantages and disadvantages of various types of drawings.
10. Use terms as cornice, sill, window, door jamb, arch, footing.
11. Elementary knowledge of building trades.
12. Types of architecture: Spanish, Italian, Colonial, English.
13. Steps involved in building and financing a home.
14. Importance of accuracy and speed in the drafting room.
15. Elementary knowledge of patternmaking and foundry work.
16. Elementary knowledge of machine operations.
17. Elementary knowledge of electrical practices.
18. When and how to use graphs, charts, and diagrams.

Principles of Design—I

Franklin H. Gottshall

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Again and again the criticism is heard that the industrial-arts teacher does not know design. In this series the author will attempt to formulate the principles and to show how they may be applied.

MANUAL-ARTS TEACHERS have frequently been accused of turning out projects of inferior quality when measured by standards of good design. There is no doubt that this accusation is true in some cases, especially since it is most often heard from men engaged in the teaching profession, who should know what they are talking about.

The time has come when no one engaged in teaching any form of manual art can afford to be ignorant of the laws and principles of good design, or neglect this important phase of craftsmanship. The spirit of fine craftsmanship is abroad, and its deft touch is awakening a consciousness long dormant, which is sure to make itself strongly felt, within the next few years, in the work done in our schools. Its coming to life is evidenced by the forming of various amateur organizations, such as The National Homeworkshop Guild, and others of a similar nature. Organizations of this kind are bound to result in great improvements of technique and skill through group activity, and because of the spirit of friendly rivalry that will naturally enter into such activity. The growth of such organizations should be interesting to watch, and it will be interesting to see what part will be played in them by men actively engaged in the industrial-arts field as teachers.

A knowledge of the principles of good design is important, and should be cultivated by every person who wishes to turn out quality products. If such knowledge goes no further than the ability to distinguish a good design from a poor one, it will be worth while. The general public is becoming more design-conscious, and if Johnny brings home a finer piece of work, not only will he be the richer, but the teacher and the profession as a whole will benefit. More real effort should go into the planning of projects to make them beautiful. The old lot of common-run projects should be critically overhauled, if not entirely thrown out, and a new set of more interesting, well-designed projects substituted. A famous writer on furniture has pointed out that there is no lack of good design, but that it is being shamefully neglected.

To design projects, be they of wood, metal, clay, or other materials, one must be familiar with the principles of good design. These are simple, and a few of them, constantly kept in mind, will result in great improvement in quality. The great furniture styles of the eighteenth century are richly indicative of conscious planning along these lines; and anyone who wishes to go to the trouble may learn most of the things he needs to know about good design from them. Study them with profit, the work of Hepplewhite, Sheraton, and others; or scoff at them for being out of date, and yours will be the loss.

The writer has been asked to prepare a series of articles dealing with definite and practical principles of design, which may be applied to industrial-arts projects. These will have application, principally, to objects made of wood, but in many cases the rules will apply equally well to objects made of other materials, and in some cases definite applications to metals or other materials will be made.

Three things are necessary to make a design good: the object must be *useful*, it must be *durable*, and it must be *beautiful*. These are results to be secured by conscientious planning. The layman often recognizes beauty in an object, when he sees it, but is unable to detect the secret of its superiority. Beauty of the final product is an end worthy in itself, and one that is seldom inimical to usefulness. Some of the important elements that help to make an object beautiful are: spaces properly divided, an attractive outline, good proportions, properly balanced elements, appropriate ornament, materials of fine quality, harmonious color combinations, and fitness to surroundings.

The Primary Mass and Its Subdivisions

We will call the object which we wish to design a primary mass. The primary mass may be a chair, a vase, or an andiron. The primary mass is usually composed of several design units. A desk, for example, will have a front, two ends, a top, etc. Each of these will receive individual treatment when the design is being formulated. Most primary masses are either definitely vertical or definitely horizontal. Thus dominant lines should lead the eye in a vertical direction on a vertical primary mass, and horizontally on a horizontal primary mass. Anyone who has ever noticed a person wearing a sweater with prominent stripes running in a horizontal direction will realize how incongruous the costume is, seeming to cut the person

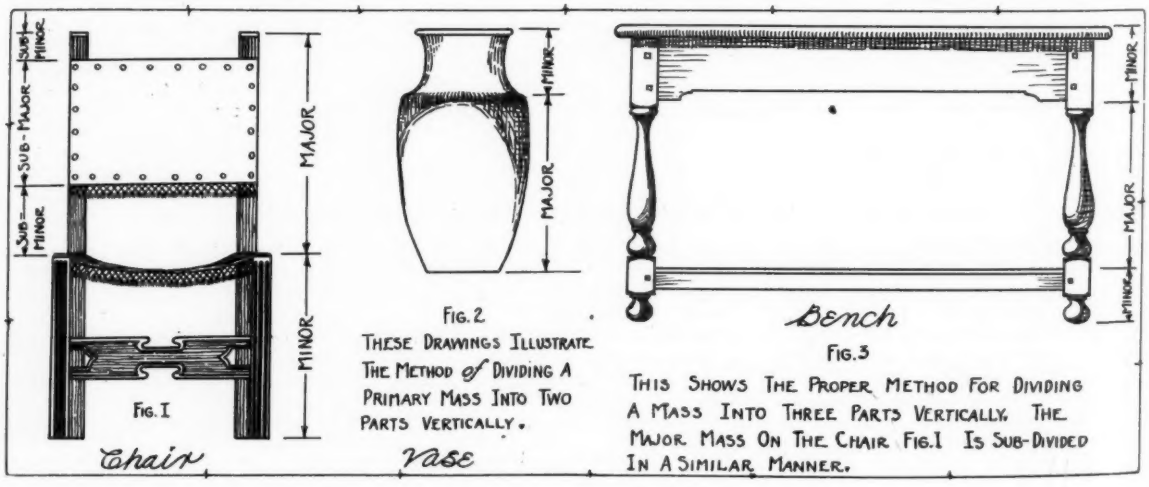


FIG. 1

FIG. 2
THESE DRAWINGS ILLUSTRATE THE METHOD OF DIVIDING A PRIMARY MASS INTO TWO PARTS VERTICALLY.

FIG. 3
THIS SHOWS THE PROPER METHOD FOR DIVIDING A MASS INTO THREE PARTS VERTICALLY. THE MAJOR MASS ON THE CHAIR FIG. 1 IS SUB-DIVIDED IN A SIMILAR MANNER.

into segments, because the lines are out of harmony with the vertical structure of the body. The same thing may happen if the horizontal lines on a vertical primary mass are too prominent. A primary mass should seldom be square or round for reasons that will be explained in detail in subsequent articles.

Whether there be two or more design units they should not all be of equal importance. Every primary mass should be

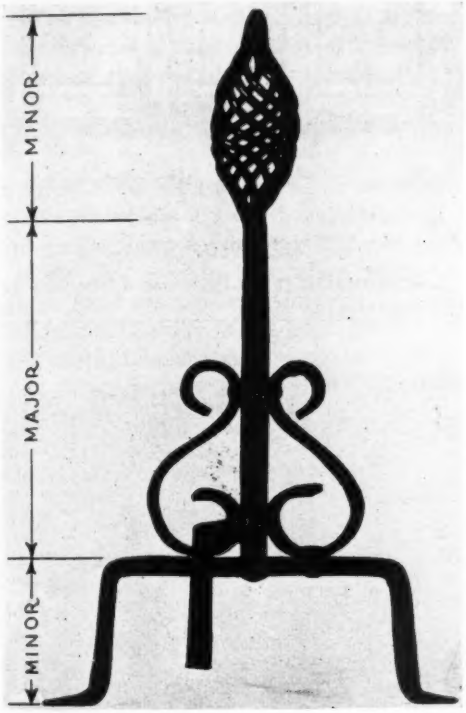


Fig. 4. The primary mass and its subdivisions

composed of major and minor masses, or areas. These, in turn, may be subdivided, and the subdivisions may be of equal or unequal size and importance. This principle, giving dominance to some elements over others, is one of the most important to be kept in mind by the designer who wishes to do effective work.

Divisions of a Primary Mass Vertically

Both vertical and horizontal primary masses may be divided vertically and horizontally. Usually it is best to make the vertical division first, and then the horizontal division. It is also to be remembered that the vertical division of a mass is made by horizontal lines, and horizontal division by vertical lines. A primary mass, or a subdivision thereof, may be divided as follows: If it is to be divided into two parts vertically, one part should be greater than the other. The greater area may be above or below the minor area. The sizes of these areas will be determined by the laws governing good proportion, which will be discussed in a later article. This rule is well illustrated by the objects in Figures 1 and 2. In no case is it

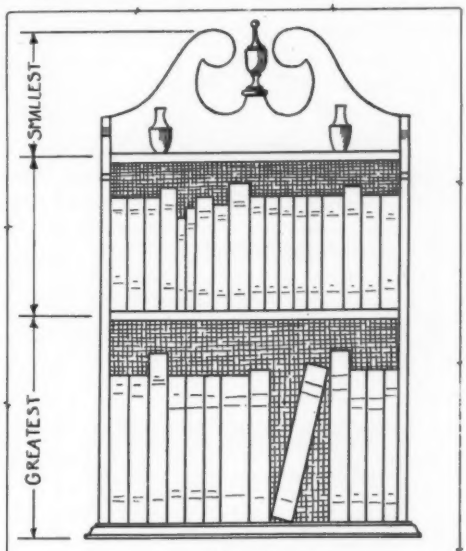
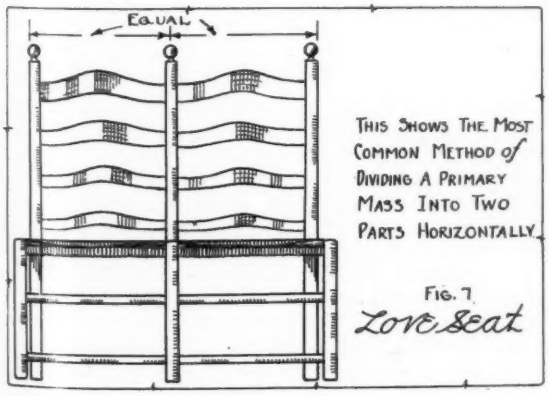


FIG. 5
Book Shelves
THIS IS THE THREE PART DIVISION METHOD IN WHICH THE LOWEST AREA IS THE GREATEST & SUCCEEDING ONES ARE SMALLER.

desirable to have the two areas equal. A vase that bulges in the middle, that is, if it is barrel-shaped, lacks interest.

When a primary mass is to be divided into three areas vertically, two methods are desirable. The divisions may all be unequal, with the largest one between the other two. This method is followed in the design of many beautiful objects. Figures 3 and 4 show examples of this method. Another method is to put the greatest area at the bottom and make each succeeding area smaller (see Fig. 5).



THIS SHOWS THE MOST COMMON METHOD of DIVIDING A PRIMARY MASS INTO TWO PARTS HORIZONTALLY.

FIG. 7
Love Seat

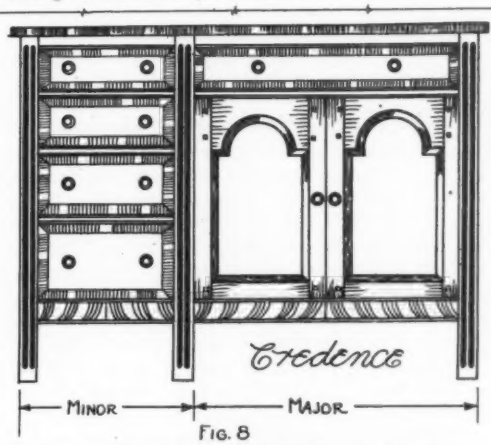


FIG. 8
THIS IS THE MOST EFFECTIVE TWO PART HORIZONTAL DIVISION SCHEME. IT IS MORE DIFFICULT THAN THE METHOD SHOWN IN FIG 7. & NOT ALWAYS PRACTICAL.

If a primary mass is to be divided into more than three parts vertically, the most practical plan to follow is to first divide it into two or three major areas, using the methods already given, and then treat each of these individually to determine necessary subdivisions. This is a logical procedure, and prevents the problem from becoming too involved. Another method is to make the lowest area the greatest, making three or more succeeding areas progressively smaller. This scheme is most successful if the variation is not the same for each space. Figure 6 shows a highboy which illustrates both of these principles admirably. In this piece there are a great number of divisions, but they are grouped in a manner so as to make the design reasonable and orderly. By first separating it definitely into two major areas, and then subdividing these, we reduce the chances of having the problem become too complicated. The divisions immediately become interesting design units which may be attractively subdivided.

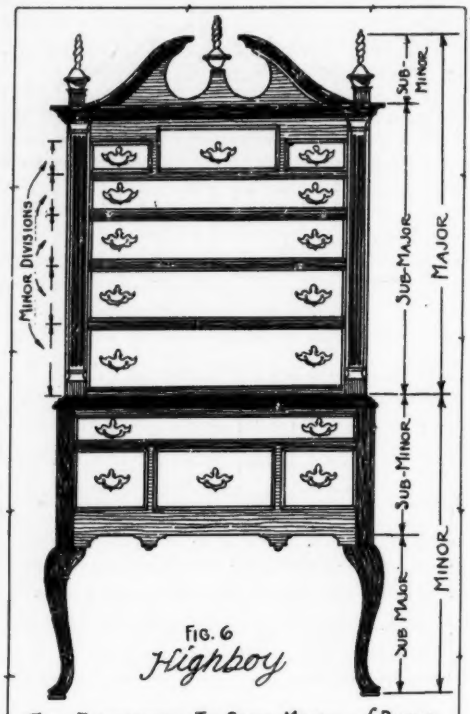


FIG. 6
Highboy

THIS ILLUSTRATES THE PROPER METHOD *of* DIVIDING A PRIMARY MASS VERTICALLY INTO MORE THAN THREE PARTS.

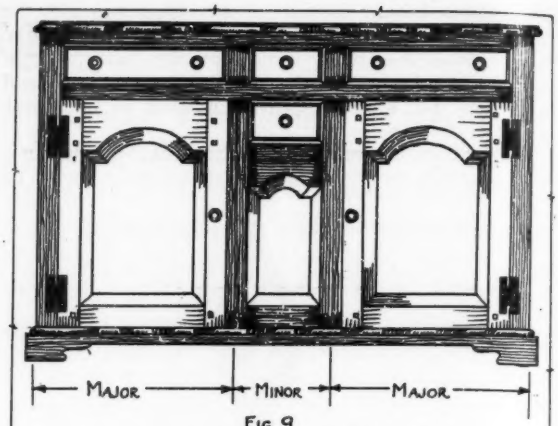


FIG. 9
Cupboard

THIS IS AN INTERESTING METHOD FOR DIVIDING A MASS INTO THREE PARTS HORIZONTALLY.

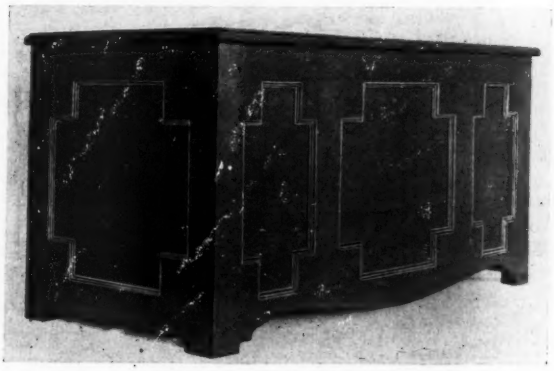


Fig. 10. The primary mass and its subdivisions

Divisions of a Primary Mass Horizontally

When a primary mass is to be divided horizontally into two parts there are two methods that may be followed. The choice will depend upon the type of piece being designed. When a mass is divided into two parts horizontally, the parts are usually equal in area and form. This rule is illustrated in Figure 7. It is the most common method. Thus the two areas are bisymmetrically balanced. Another method which is sometimes used, is to make one area greater than the other, but a sense of balance must be made to exist. This is known as occult balance. This latter method is the most effective two-part division, but more skill is required to make it effective and satisfactory. The smaller area is made to balance the greater area by properly subdividing it so as to give it greater weight.

When a primary mass is to be divided into three areas horizontally, three methods may be followed. The mass may be divided into three equal areas horizontally. The very fact that there are three areas gives this scheme the necessary amount of interest to make it possible. It is, however, the least interesting of the three methods, and should not be used except where the other two are not practical. A second method is to place a small area between two larger ones of equal size, as shown in Figure 9. This will be interesting if well done. A mass may be divided into three areas horizontally by putting the greatest area between two smaller ones of equal size. This is the most beautiful three-part scheme, and one that has always found great favor with designers. Figure 10 shows this method used in the design of a chest.

The methods given above will apply to the division of primary masses as well as to minor divisions and subdivisions thereof.

The Supervisor's Duty

"The first purpose of the supervisor, to diagnose or interpret the learning situation, may require inspection, research surveys, all the activities necessary for him to gain a complete understanding of the learning situation. The supervisor, therefore, must have a sound philosophy of education and must be able to analyze the facts of the learning situation in terms of the future." — *J. M. Gwinn.*

"Supervision, if it is to be effective, must help teachers to secure an effective working knowledge of the tools of teaching. Such tools are instruction sheets, tests, instructional material, teaching devices, suitable equipment, and other aids. Theory and practice must be coördinated." — *John E. Fintz.*

Free-Hand Orthographic Projection

Harvey W. Waffle

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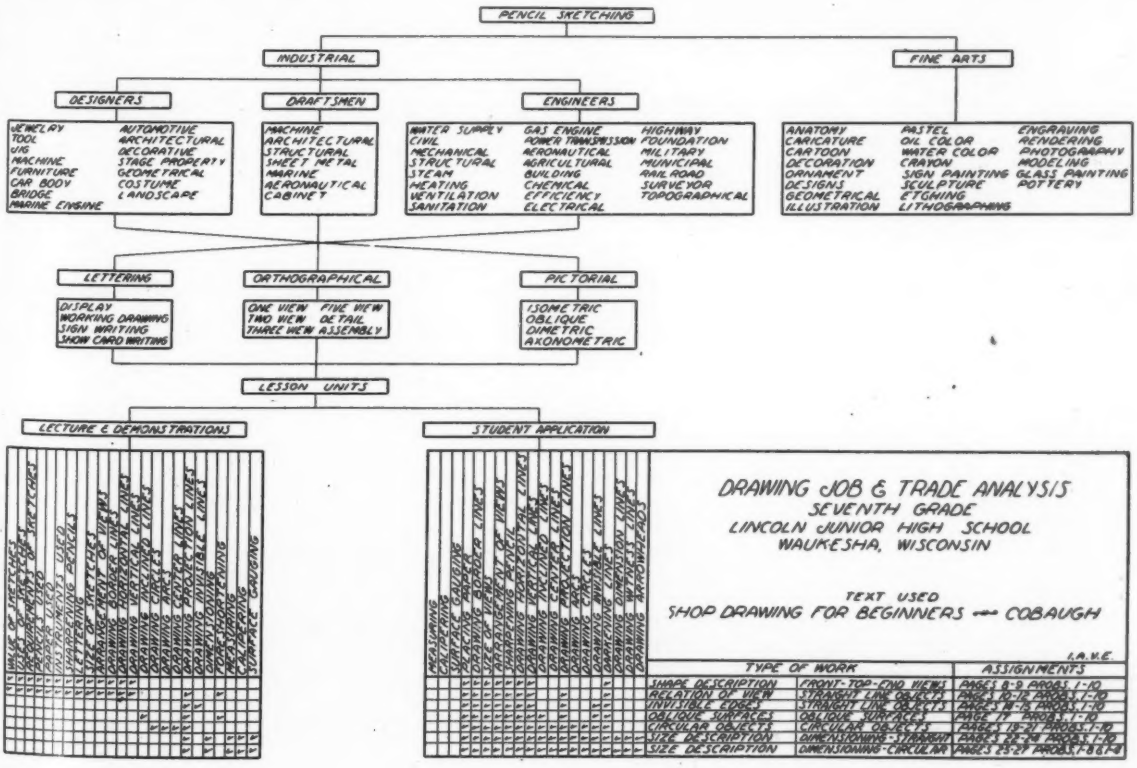
A description of a helpful analysis which can be adapted to any shop subject.

THE introductory lesson in a drawing class usually consists of a brief talk on mechanical drawing, emphasizing its value as the "language of industry." Two considerations also should be emphasized to the students: (*a*) the value of drawing to the other subjects, trades, and professions, and (*b*) where and how it is used.

The value of mechanical drawing to other subjects, trades, and professions is a worth-while study in itself. The correlation between drawing and the trades is often briefly discussed in these short talks, usually through its local applications. Time can be profitably spent in making a study of the applications of drawing. The application and close association of mathematics to drawing is frequently mentioned, but very little is said concerning the other academic subjects. English must be correctly used in the notes used on drawings, and the lettering learned in the drafting class helps in notebooks and booklets produced in all of the other subjects. There are several instances where graduating high-school students have entered the universities and colleges to take up one of the several engineering courses not knowing that mechanical drawing had any close correlation to the subject until it became one of their required subjects. How much easier it would have been for them, had they obtained a good foundation of elementary drawing in high school. Many students graduate from high school and enter shops only to find out that drawing would have helped them read the blue prints which they must now learn to decipher. Night-school classes are usually filled with such examples. This tends to show that the importance of the subject has not been impressed upon the minds of the students in school. Too often it is made an easy course where a weak student may easily acquire a credit toward graduation. The use of drawing in the professions is not so clearly defined except for teachers. Others often use drawing knowledge in reading blue prints when building a home, following a hobby, etc.

It is important to point out that a shop sketch is frequently used in the form of preliminary drawing in industry, later to be made into mechanical drawing. Beginning students are always anxious to start with the drawing instruments. They usually are unable to see why they should make the drawings free-hand except as a matter of discipline. To impress upon them the method followed in industry helps to iron out this difficulty. Teaching them to make the preliminary



studies on paper enables them to save a great deal of time in the making of mechanical drawings. It is often interesting to the students to know that sketching is used in the fine-art subjects as well as in the industrial courses offered in the schools.

A job and trade analysis laid out in chart form will be found to be an aid to the instructor as well as a means of impressing the student with the importance of the subject to the trades and industries. On this same trade analysis the jobs may be sorted out to include only the essentials necessary to the learning process. This job analysis is purely for the benefit of the instructor that he may check that which is taught against that which should be taught. It helps to sift out the unnecessary repetition in the teaching units. This analysis may be made into a complete outline of the course of study with its plate assignments, related informational matter, demonstrations, etc.

The job and trade analysis shown in Figure 1 covers the subject of "Free-Hand Orthographic Projection" as is given in the beginning course of drawing in the junior high school. It is based upon the textbook *Shop Drawing for Beginners,* by Cobaugh, published by The Bruce Publishing Company, Milwaukee, Wisconsin. It could be made to apply equally well to the course submitted by Jonathan Bright of the Academy High School, Erie, Pennsylvania, which appeared recently in this magazine. These two courses are very similar, differing chiefly in the problems used:

A. Organization

1. The students are supplied with pencil, cross-section paper (8½ by 11), pad of plain typewriter paper (8½ by 11), eraser, and 3½ by 5-in. ruled lettering cards.

2. Short talks are given concerning the value of pencil sketching, and as to where and how it is used in the trades and industry.

3. Demonstrations are given to the class just before the principles are to be applied by the students. These demonstrations show that perspective drawings do not show either the true shape or the true size of the object, but that orthographic drawing does give both the true shape and the true size of the object. The student is shown how to hold the pencil correctly in drawing lines, how to sharpen the pencil correctly, how to gauge border lines from the edge of the desk or drawing board, how to draw circles without the use of the compass, how to arrange the views on the sheet, etc.

4. Lettering is taught as a part of the subject. Five to ten minutes of the beginning of each period is devoted to the study of the shapes of the letters, strokes, and to lettering practice.

B. Units of Instruction

1. *Shape Description.* The idea of the change of position of the observer is all that is desired. No attempt is made at this time to consider the relation of views.

The front views of the first six problems are placed on the first sheet. The top views of the same problems are placed on the second sheet. The right side views of the same problems are placed on the third sheet.

2. *Relation of the Views.* Proportion and placing of views are taken up first, starting with very simple problems of straight horizontal and vertical lines and working into the more complex problems involving invisible edges, center lines, circles, arc, tangents, etc.

a) Simple Straight-Line Objects: These ten problems consist of straight horizontal and vertical lines not involving invisible surfaces.

b) Invisible-Edge Objects: These ten problems involve the same principles as the simple objects except that the objects have the notched surfaces to be represented by dotted lines. These drawings require nothing but horizontal and vertical lines.

c) Oblique Surfaces: These ten problems involve objects having oblique surfaces, not involving hidden planes. The difference between representing oblique lines and straight lines is taught. This principle is very important to the advanced drawing class in the study of the true length of lines.

d) Circular Objects: These ten problems involve the use of center lines. Demonstrations must be given to show the methods of sketching circles and arcs without the use of the compass. The correct order of laying out a problem involving center lines is quite important.

3. *Size Description.* This unit of work is not required but is used as an introduction to size description when the brighter members of the class have finished the unit on shape description. Only the elementary principles are taught as a foundation for their unit of work, as it is taught in a later course in more detail.

C. Technical Information

1. In viewing an object, the position taken up by the observer immediately suggests the name for that view. Thus, when looking down from above the view is called a top view. In like manner, a view from the left side is called a left side view, etc.

2. The views of the object commonly used are the top, front, and right side views.

3. The front view of the object will show the true height and length of the object, the top view will show the width as well as the length, and the right side view will show the width and the height of the object.

4. Begin drawing a sketch by drawing the view which shows the shape best. Carry all of the views along together without attempting to finish one view before starting another.

5. The views of an object should be placed at a reasonable distance apart and so arranged on a sheet that a pleasing appearance results.

6. Edges of an object are represented by firm lines, heavy enough to be plainly visible.

7. Broken or dotted lines are used to indicate edges which are not visible. The lines are a little lighter in weight than the visible lines. The dashes should be about ⅛ in. long with about 1/32 in. space between them for the size of sketch used on this size sheet.

8. A dotted line touches the line from which it starts, dotted lines touch at the corners, but if a dotted line is a continuation of a full line, a space is left between the full line and the first dash of the dotted line.

9. Extension lines are light full lines drawn from the outline and extending past the arrowhead. The dimension line is a light full line.

10. Figures should be carefully made and of a size easily readable but not so large as to overbalance the drawing. About 3/16 in. high is recommended. Fractions are made with a horizontal division line. Figures for fractions are made three fourths the height of whole numbers.

11. In placing dimensions, the man who is to read the drawing must be kept in mind. Select the view which shows the shape best and give two dimensions of each part, giving the third dimension on one of the other views. Horizontal dimensions should be read from left to right, and vertical dimensions from the right side of the sheet. Dimension lines should never cross extension lines. Larger dimensions should be placed outside the smaller dimensions. Never repeat dimensions. Diameters of circles and radii of arcs should be given.

12. Neatness is a very desirable quality at all times, but

never more so than when making a drawing. All lines must be clear and clean-cut.

D. Acquired Skills

Because of their experience in free-hand orthographic projection, these beginning students of drawing should be able to:

1. Draw horizontal lines free-hand or by gauging from the edge of the board.
2. Draw vertical and oblique lines.
3. Draw dotted lines to properly represent an invisible surface.
4. Draw center lines of the proper weight.
5. Draw arcs and circles without the use of the compass.
6. Locate three views of an object on a sheet of paper with proper spacing, so placing the views in the working space left on the sheet after provision has been made for title, etc., that the sheet presents a neat appearance.
7. Make a three-view drawing of various objects as follows, using vertical, horizontal, oblique, dotted, and center lines on both visible and invisible edge objects.
   a) Simple straight-line objects.
   b) Invisible edge objects.
   c) Oblique surfaces.
   d) Circular objects.
8. Locate dimensions properly on a simple sketch.

(This last skill is supplementary and given only where time permits.)

Adding a Metal-Casting Unit

Geo. A. Willoughby

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Metal casting offers numerous experiences to the student which not only are interesting but exceedingly helpful in learning many things about this important branch of industry.

THE adding of a small metal-casting unit to a typical general shop is not a difficult task, and the unit is quite inexpensive. Probably a description of a definite example will offer suggestions which may be followed by others in this development.

Figure 1 shows a corner of the general shop just after the unit had been installed. Two gas furnaces, a small melting furnace, and a three-burner general-purpose furnace were purchased. The latter also provides for elementary forging and sheet-metal work if necessary. Some old tables, a sand container which was constructed in the shop and which also serves as a workbench, comprises the rest of the equipment needed for this unit.

Sand was readily obtainable, and with two riddles, two molders' tools, and some homemade rammers and flasks, together with a little parting, and the metal-casting unit was ready for operation.

The work was started with a few patterns. Some old automobile-motor pistons were melted up, and castings such as those shown on the shelf in Figure 1, were produced in ever-increasing numbers, and at practically no expense.

Since this modest start, several years ago, the workbenches have been improved and a large melting furnace constructed. The pouring floor has been confined by a frame of angle iron to protect the concrete floor, and the melting bench has been covered with transite board to make it fireproof.

Fig. 1.

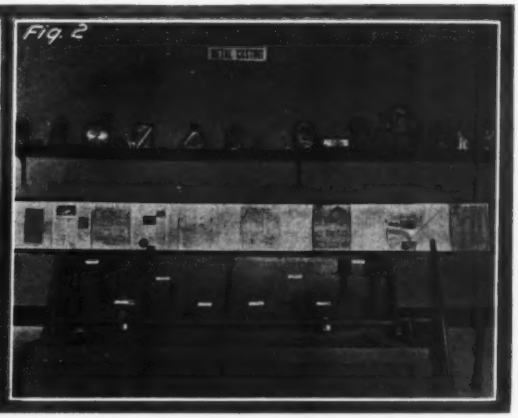
Fig. 2

Figure 2 shows the sand container and bench as it is today. This small and inexpensive unit has proved itself very valuable in the general shop. It has not only provided much experience and aroused interest in one of the most fundamental industries of the country, but it also has developed an understanding of the principles of patternmaking. The elements of patternmaking in the woodworking course now have meaning, because the maker of a pattern can actually try it out in the metal-casting corner of the general shop.

The Need for Objectives

"The study of objectives is the first step in the building, or continuous revision, of the curriculum. Not until the immediate and long-time aims are established or verified can the curriculum maker proceed with the selection and organization of subject matter and activities through which objectives may be achieved." — *Burl N. Osburn.*

"What we teach, why we teach, and how we teach, offer many problems of organization. In the consideration of the first of these, What we teach, it is necessary, before organizing any course of study, to set up the goals which we expect our teaching to reach. This brings up the problem of objectives." — *Allen A. Nellis.*

INDUSTRIAL ARTS *and* VOCATIONAL EDUCATION

J. J. Metz, Editor

The School Year 1934-35

Before long the ordinary routine of schoolwork will again dominate the teacher's time. In most cases the teacher will be back in the same room in which he taught last year, and probably the year before. He will, therefore, be submerged in an environment to which he has become adjusted.

This very fact carries with it something which the teacher has to bear in mind while making preparations for the coming school year. The sound of the bell or the buzzer which opens and closes the class period, the familiar appearance of the room, the characteristic odor of the materials used, the familiar sight and sound of the students entering or leaving the shop, yes, even the sounds produced by the school as a whole, have probably produced conditioned reflexes of which the individual teacher may not be, as usually is not, cognizant.

The very fact that these conditioned reflexes may influence one without one's knowledge, shows how necessary it is to take their existence into consideration. These conditioned reflexes may act detrimentally if they have set up inhibitions that do not make for teaching efficiency and progress. This must be taken into consideration by the teacher who is forehanded enough to spend part of his vacation in preparing plans for the opening of school.

He must remember that if his plans are to be really effective, they must be more than mere mental pictures. If he is satisfied with anything but a very definite and specific plan — preferably in black and white — he may find that upon entering the old, accustomed environment of last year's shop, he will don, with his shop coat, also the habits which were built up under these surroundings in the past.

Considering all this, it is well to make the plans for the coming year as definite and specific as possible, and to be forewarned and forearmed against any and sundry inhibitions which might nullify some of the efforts at improving the educational work offered in the school shop during the year 1934–35.

The determination of what changes are to be made, will rest, of course, with the individual teacher. There are so many things that need scrutiny and probable change. Probably the setting up of a list like the following, might assist in determining just what to do. Although this list is far from complete, it may serve as an incentive to start this necessary work and may be expanded to suit any condition. There are still several weeks before school opens, and this preparation for making the next year's offering in the school shop bigger and better than ever before, is still possible.

1. Have I a definite outline of instruction?
2. Is this outline of instruction in such form that it can bear the scrutiny of my supervisor, principal, fellow teachers, students, parents, and the taxpayer in general?
3. Have I carefully checked my outline against the objectives of my course?
4. Have I got a good grasp of what the objectives for industrial arts and vocational education should be?
5. Have I planned my work so that it really can become an integral part of general education?
6. Have I outlined the procedure for the opening class of 1934–35?
7. Does this opening-class procedure recognize the feeling of curiosity which the normal student has for my particular part of industrial-arts work?
8. Have I planned this procedure so that the student can partially satisfy this curiosity by the actual handling of tools and materials at the very first attendance in my shop?
9. Does my outline of instruction for the coming year embody a maximum of student activity?
10. Have I made any improvement in my method of grading and of recording the progress of my students?
11. Have I carefully rechecked my shop arrangement to see whether it could not be improved?
12. Are my stock-storage racks well planned?
13. Are my small-parts, remnants, and salvaged-parts storage racks so arranged that they make economy easy?
14. Is all my shop equipment in good order?
15. Can the lighting and ventilation of my shop be improved?
16. Is the question of safety and of observing safety recognizable in the appearance of my shop?
17. Is the appearance of my room inviting?
18. Does the general appearance of the shop give the impression of efficient orderliness?
19. Have I sufficient storage space for partially completed projects, or can this space be arranged for by careful planning?
20. Have I a good bulletin board?
21. Do my plans include a regular program of bulletin-board displays on safety, character education, guidance information, related materials, and scientific facts, current events, and the like?
22. Am I planning for an exhibit of the work produced in my shop?
23. Am I planning for some type of publicity for industrial-arts and vocational-education work, be that through the local papers, the school news, the radio, special exhibits, or an open-house demonstration?
24. Am I going to contribute something to my professional growth by subscribing for and reading the magazines specially written for my field?
25. Am I planning on preparing myself for doing a better teaching job by including a provision in my financial budget that will permit me to attend summer school next year?

Planning for Economy

While the economic pressure on the schools is being slowly withdrawn, as is evidenced by the increasing number of cities that are raising the salaries of their teachers, the economic necessity of keeping down school-shop expense is still with us. How to achieve this economy is a problem that requires careful planning by the teacher, and frequently entails much personal exertion.

The use of salvaged material has been mentioned again and again. Under this heading, the use of the lowly tin can probably ranks first. There are many other possibilities, however. Take, for instance, the many oddly shaped bottles that are now used in the marketing of foods, which can be used in various ways. Many basements, and attics also, may yield bottles and jugs of this kind, that were in use many years ago. These same storage places may yield antiques in the shape of kerosene lamps, jardinieres, and the like, that may serve admirably in the school shop. Much old furniture which may be repaired, rebuilt, or refinished, may also be found if the students can be induced to search for it and bring it to school.

Then there is the possibility of obtaining scrap material from industry. This may assume many shapes and cover many materials, depending upon the varieties of industrial work carried on in a given city. In the larger communities where there are larger scrap-iron and auto dumps, a wealth of material may be obtained at small expense that will serve for many interesting and instructive projects.

A canvass of the teacher's community may disclose many other types and sources of materials. It may also show possibilities to the teacher who has not tried this method of securing materials, that will be decidedly worth while.

Parasitic Drag

Aëronautic engineers are ever striving to reduce what they call "parasitic drag" on the airplanes which they design. Their ultimate goal — their ideal, one might say — is to produce a perfectly stream-lined airplane. Not the slightest projection on the airplane is permitted if the designer can devise a way to remove it. The question might be asked — why all of this anxiety about trifles? — but the aëronautic engineer will answer, "Trifles, indeed. It takes but a small obstruction to reduce the speed of an airplane ten; twenty, or more miles per hour."

The salesman, intent upon making the quota of sales apportioned to his territory, strives to reduce the sales resistance against his line of goods to a minimum. He does not shun any labor if it but makes the customer more ready to buy. He does not call the customers' objections, "parasitic drag"; he calls them "sales resistance," and he strives to overcome them, or at least to minimize them.

The past few years have shown that industrial arts and vocational education also possess considerable parasitic drag or sales resistance. It is necessary that everyone connected with these phases of education strive to his utmost to remove as much as possible, anything and everything that might militate against the efficient functioning of these branches of practical education in the school. Some teachers, however, do not seem to have sensed this necessity, or at least, they seem not to have deemed it necessary for them to make personal exertions toward indicating that their work must more than show its value if it is to survive in the curriculum.

As an example: Recently the principal of a large technical school asked all of his teachers to carefully review their budgets for the year 1934–35. He told them that the utmost economy would be necessary, as the appropriation made by the superintendent for their school had been definitely set at a much lower amount than had been the case in previous years. He urged everyone to do his share in planning to achieve greater economies.

At a stated time, the budget statements of the various departments were gathered and tabulated. Most of the department heads indicated that they thought they could operate, if need be, at even lower levels than those that had already been imposed. There were three or four, however, who could see no way at all of reducing the expenses of their department.

Finally, after several unsuccessful attempts by the principal to get his budget down to the amount apportioned for his school, he called another teachers' meeting. Again he informed them of the necessity of paring departmental requirements, and wound up with the statement that salaries would have to be reduced if the budget could not be met in any other way.

Strangely, after this admonition — or should it be called a threat — these stand-patters could see their way clear to reduce departmental requirements so that the budget allowance came within the amount apportioned to the school. Like the little boy who must first be threatened with punishment before he obeys, these teachers failed to see that it was up to them to help make the operation of the school possible. They did not see that they, too, had to scheme and plan so that their work could be done more economically. They no doubt felt that other departments could be run for less money, but that their own subject was different. It had always cost a given amount per year and this, to them, sacrosanct expenditure could not possibly be reduced. It required a threat to make them realize that they, too, had to help reduce the parasitic drag which threatened the smooth running of their school.

It may be correct for a teacher to assume that he has always conducted his department as economically as possible and that further reductions cannot be made without impairing the service, but under conditions such as the world is passing through at present, it is the duty of every teacher not to rest his decisions on assumptions but rather on serious and determined efforts to devise new, and if possible, cheaper ways of reaching the goal.

Improving the Attendance

A. R. Nichols

San Jose, California

The development of habits of promptness on the job is one of the worth-while outcomes of industrial arts and vocational education. A method which accomplishes this is therefore worth while studying and adopting.

THE attendance chart, illustrated and described herewith, was devised in the vocational department of the high school at San Jose, Calif., with the idea of developing responsibility for attendance in the shop classes.

The chart shown in Figure 1 indicates the attendance rating for the first week and the first two days of the second week of the semester. This attendance chart was placed so that it was visible to all shop students as they passed to and from the shops to their classes. Each shop teacher marked his daily attendance rating on the chart, so that the standing of the different classes could be compared from day to day.

The names of the shops at the right of the chart are arranged in such a way that they can be moved independently. This permits them to be shifted from day to day, so that a glance is sufficient to show how the standing of one class compares with that of the others.

In order to make it as easy as possible for the teacher to calculate the daily standing of their classes, the table shown in Figure 2 was prepared. For an absence the penalty is two points and for each tardiness one point. The table has been calculated for classes varying in enrollment from 14 to 35, and for penalties ranging from 1 to 10 points.

SHOPS	CLASS ENROLLMENT		MON	TUE	WED	THU	FRI	MON	TUE	WED	THU	FRI
AUTO ELEM.	29	1000	978	967	963	961	940	970	995			
AUTO ADV.	24	1000	1000	1000	982	964	963	964	960			
ELECTRIC	22	1000	1000	1000	1000	1000	1000	1000	1000			
MACHINE	22	1000	1000	1000	995	997	998	953	976			
MILL CABINET	20	1000	1000	958	943	985	956	978	989			
PLUMBING	22	1000	1000	1000	977	920	937	923	916			
PRINTING	23	1000	989	994	997	998	999	999	999			
SHEET METAL	24	1000	1000	1000	1000	1000	1000	1000	977			

COMPARATIVE ATTENDANCE RECORD
1 ELECTRIC
2 PRINTING
3 AUTO ADV.
4 CABINET
5 SHEET METAL
6 MACHINE
7 AUTO ELEM.
8 PLUMBING

Fig. 1. Attendance chart

Attendance Record Calculation Table										
Class Enrollment	Penalty Points The penalty for an absence is 2 points, for tardiness, 1 point.									
	1	2	3	4	5	6	7	8	9	10
35	986	971	957	943	929	914	900	886	871	857
34	985	971	956	941	926	912	897	882	868	853
33	985	970	954	939	924	909	894	879	864	848
32	984	969	953	937	922	906	891	875	859	844
31	984	968	952	935	919	903	887	871	855	839
30	983	967	950	933	917	900	883	867	850	833
29	983	965	948	931	914	896	879	862	845	828
28	982	964	946	929	911	893	875	857	839	821
27	981	963	944	926	907	889	870	852	833	815
26	980	961	942	923	904	885	865	846	827	808
25	980	960	940	920	900	880	860	840	820	800
24	979	958	937	917	896	875	854	833	813	792
23	978	957	935	913	893	870	848	826	804	782
22	977	955	932	909	886	864	841	818	796	773
21	976	952	929	905	881	857	833	810	786	762
20	975	950	925	900	875	850	825	800	775	750
19	974	947	921	895	867	842	816	789	763	737
18	972	944	917	889	867	833	806	778	751	723
17	970	941	912	882	854	824	794	765	735	706
16	963	937	906	875	844	812	781	750	718	687
15	966	932	900	868	833	800	767	733	700	667
14	964	928	893	857	821	786	750	714	679	643

Fig. 2. Attendance record calculation table

In order to train the student to let his future employer know of absences before they occur all classes are informed that absences or tardiness reported to the teacher before they occur will not be penalized against his shop. Furthermore, if the boy is tardy and gets an excuse which is acceptable to the shop teacher, there will be no record made of it on the chart.

Figure 1 shows that each shop started out with a rating of 1,000. On Monday of the first week there were some students absent or tardy, and the elementary auto and the print shop dropped to 978 and 988 respectively. On Tuesday of the second week, the chart shows that the electrical department is still maintaining a perfect rating. On that day, the print shop has a rating of 999, the advanced auto shop 995, and so on.

In determining the rating for each day's attendance, the following method is used: Say that in a class with an enrollment of twenty-three students, one student is absent. This means that two points are taken off. Looking at the table in Figure 2 opposite the twenty-three enrollments under two points, the reading is 957 for the class that day. Supposing, however, that one boy had been absent and three boys tardy

Absence and Tardiness Record — Plumbing Class — Enrollment 22					
Day	Absent	Tardy	Points	Reading Table Fig. 2	Rating
Mon.	0	0	0	---	1000
Tue.	0	0	0	---	1000
Wed.	1	0	2	955	$\frac{1000+955}{2} = 977$
Thur.	2	2	6	864	$\frac{977+864}{2} = 920$
Fri.	1	0	2	955	$\frac{920+955}{2} = 937$
Mon.	1	2	4	909	$\frac{937+909}{2} = 923$
Tue.	2	0	4	909	$\frac{923+909}{2} = 916$

Fig. 3. Method of calculating the daily rating

in that same class; then the total penalty would have been two plus three, or five points. Under those conditions, the reading would have been found in the five-point column, opposite the twenty-three enrollment, and the reading for that day would have been 893. In order to calculate the rating for any particular day, take the reading from the table in Figure 2, add it to the rate of the previous day on the chart and divide this sum by two. In calculating these standings, drop all fractions.

Figure 3 shows how the daily ratings shown on the chart for the plumbing class (Fig. 1) were obtained. This class, as is shown on the chart, has an attendance of 22.

Casting in the School Shop—II

N. A. McMillan

Mount Vernon, New York

The second of a series of lessons on molding. Each lesson is built up around a project so that successive steps in the procedure can be thoroughly explained and illustrated. Part I of this article appeared on page 14 in the January, 1934, issue of this magazine.

Gates, Risers, and Shrinkheads

BEFORE continuing with the next mold, we should give some time to the study of gates and risers.

Gating

Gating is the term applied to the methods of forming openings and channels in the sand by which liquid metal may enter the mold cavity. The terms *sprue* and *runners* are also used in the same connection in some shops.

There are practically three parts to all gates: *Pouring basin, runners,* and *gate,* as seen in Figure 8. The runner is formed by a wooden gate plug or stick made for the purpose. The pouring basin is shaped by hand on top of the cope, and the gate proper is cut along the joint surface by means of a gate cutter. A gate cutter is a thin sheet of brass 4 in. square bent to a U-shaped trough. In all cases the gate section should be smaller than any other part so that, when pouring, the runner and basin may be quickly flooded; also that the gate when cold will break off close to the casting and lessen the work of cleaning.

The object of gating is to fill the mold cavity with clean metal, to fill it quickly, and to do this by creating as little disturbance as possible in the metal.

The impurities in liquid metal are lighter than the metal itself, and they always rise to the top when the melted metal is at rest or nearly so. Advantage is taken of this important property to accomplish the first of the objects mentioned.

FIG. 7
Casting with sprue, runner and riser.

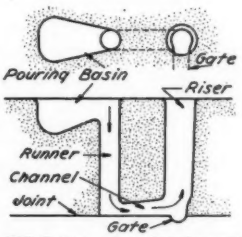

FIG. 8 Use of skimming gate

Figure 7 shows a good type of gate to use on light work. For reasons already given in Part I, the point A should have the smallest sectional area. This section should be wider than it is deep, because the hot metal necessary for light work runs very fluid.

The runners should not be more than ⅝ to ¾ in. in diameter for benchwork. When pouring, the stream from the ladle should enter at B, fill the basin at once and keep it in this condition. By keeping the pouring basin full, the impurities float on top of the metal in the pouring basin and do not enter the mold.

Skimming Gate

When particularly clean castings of medium weight are required, some form of skimming gate should be used. Figure 8 illustrates one of several practical forms. They all depend for their efficiency upon the fact that the impurities will rise to the surface. In Figure 8 a good-sized riser is placed about 3 or 4 in. from the runner, and a channel cut in the cope joint, connecting these two. The gate should be cut in the drag side of the joint, just under the riser but at a right angle to the channel. The metal rushing down the runner is checked by the small size of the gate and so washes any dirt or slag up into the large riser. The level of metal in this riser must be sustained by sufficiently rapid pouring until the mold is filled.

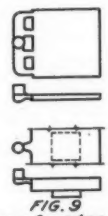

FIG. 9
Use of gates on heavy and thin castings.

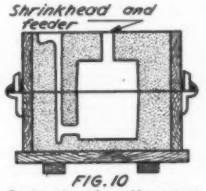

FIG. 10
Gate showing the pouring of a deep mold at the bottom.

Risers and Shrinkheads

A riser is a hole cut in the cope of a mold to permit the metal to rise above the highest point of the casting. It serves a number of purposes. It enables the molder to see when the mold is filled and this warns him when to stop pouring to avoid straining the casting. It may be used to avoid pocketing gas in a high part of the mold by being placed on this high point of the casting. It may be used as a flow-off, being placed at the highest part of the mold. Through this flow-off, a softer casting will be produced at the point where the riser is attached, than would be the case were the metal permitted to simply rise and fill the mold. A riser placed near thin parts of castings at the joints of molds, and connected to these by a gate, thus permitting the metal to flow through these gates into the riser, will often insure castings more true to the shape of the pattern than would be the case were the riser omitted.

Large risers are used for shrinkheads or feeding heads as in Figure 10. Large bodies of metal while solidifying, require a certain amount of molten metal to be fed to them in order that the casting may entirely fill the mold, inasmuch as metal shrinks when solidifying. Feeding heads or large risers are provided with large gates between the riser and the casting. The gate must be of such size that the metal in it will not become solid before the casting solidifies. It is essential that the metal be permitted to flow freely from the feeder head to supply all deficiencies due to the shrinkage of metal in the mold.

Castings up to a certain size may be fed from feeder heads

by gravity, if the feeder or shrinkhead is properly proportioned. With larger castings, a gravity feed would require a basin at the top of the riser of convenient size and to avoid this and use a smaller riser, which may be easily broken from the casting, pumping or churning is resorted to. The molder will place on top of the casting, or at times alongside of it a riser of sufficient diameter to permit the entrance of an iron rod. This riser is connected with the mold proper by a larger gate. After the mold has been poured, the iron rod is inserted in the riser and moved up and down and around the sides of the riser. Molten metal is poured into the riser constantly and by means of the rod, the hot metal is kept in motion in the riser and gate and prevented from solidifying until after the casting itself has set or frozen. As the casting shrinks in solidifying, it draws on the liquid in the riser for sufficient metal to make up the shrinkage and fill the mold completely. The operation above described is known as churning or pumping. When the pumping rod is first pushed down into the riser, care should be taken not to allow it to come in contact with the sand forming the bottom of the mold, and thus tear up the sand which might find its way back into the mold and thus spoil the casting. In moving the iron around in the riser, the opening kept clear should be as large as possible. The churning rod should be struck every few moments with a short bar of iron to prevent a ball of iron from forming on it at the point where it enters the riser. If the casting is of such size that a considerable time is required for churning, extra churning rods should be provided for use when the ball forms, as it will do eventually. The churning rods should be heated before use to prevent their freezing the riser when they are inserted in it. As the riser is to furnish hot metal to the rest of the casting, it must be kept hot longer than any other portion. In churning large castings it is advisable to fill the top of the churning head with powdered charcoal to exclude the air from the surface of the iron.

Question Sheet

Risers and shrinkheads

Directions: This is a multiple-choice test. Underline the correct response (or responses), to each statement.

1. The three parts of a gate are (1) sprue, (2) joint, (3) runner, (4) channel, (5) riser, (6) feeder.
2. The smallest portion of a gate is the (1) runner, (2) point that connects the casting, (3) riser.
3. The main function of a skimming gate is to take care of the (1) impurities, (2) skimming process, (3) surplus metal.
4. Three important functions of a riser are (1) liquid shrinkage, (2) sand breaking, (3) escape of gases, (4) supplies metal to the casting, (5) for overflow of metal, (6) to hold the shape.
5. A shrinkhead is placed at the (1) middle, (2) top, (3) point where the metal can be fed.
6. In order to keep a casting from shrinking out of shape use a (1) heavy gate, (2) shrinkhead, (3) runner.
7. It is necessary to place several gates on a thin casting to insure (1) warping, (2) running of metal, (3) solidifying.

Instructor's Remarks:

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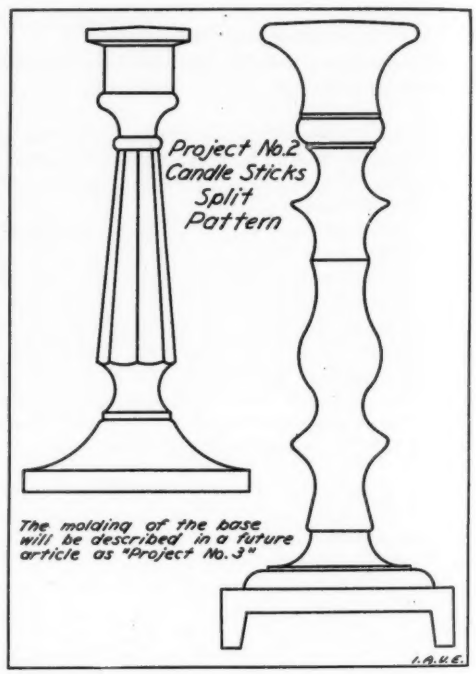

Project No. 2

Project: Molding a split pattern — candlestick.

Suggestive projects: napkin ring, dumbbell, or any cylindrical article made into a split pattern.

Tools and Materials: Same as in Project No. 1 (see page 15, January, 1934, issue of this magazine).

Procedure

The reason for splitting a pattern into two halves — drag and cope — is to establish an accurate parting line and prevent back draft which will break up the sand or mold. It is impossible to cast everything in the drag. Differing from the first project, we are concerned with the cope, which is the upper half of the mold.

1. Lay the drag side of the pattern on the mold board. The drag side is selected as being the best side of the casting and is the half without the *dowel pins* (see Fig. 13).

2. Lay the drag flask on the mold board and proceed as before in ramming the mold.

3. Lay the bottom board on the flask and rub to a bearing, then roll the drag over.

4. Slick off the joint with the palm of the hand and blow off the loose sand. Dampen the edges of sand in the mold. Shake parting on this joint to prevent the sand from sticking.

5. Place the cope half of the pattern on the drag, as in Figure 14. Locate the cope flask on the drag and ram up the mold as before, using the sprue and riser pin as illustrated. Ram with lighter blows over the pattern as the thickness of sand is thinner than the sand near the sides of the flask. The sand here must not be packed too tightly to prevent the gas from escaping. The cope is never packed as tightly as the drag for this reason.

6. Vent the cope as illustrated in Figure 16 with the vent wire.

7. Lift off the cope flask and draw the drag and cope patterns out, as in Figure 15.

8. Cut the gates as illustrated.

9. Graphite the mold surface and place the two halves together.

10. Weight down the mold and pour the

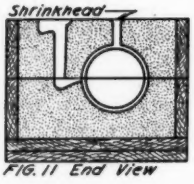

FIG. 11 End View

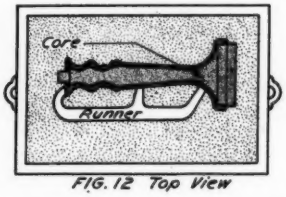

FIG. 12 Top View

FIG. 13
Drag half of pattern in position.

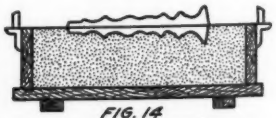
FIG. 14
Cope half of pattern in position.

metal. If the flask is to be used immediately, place a wood frame around the mold, until after pouring the metal Figure 16.

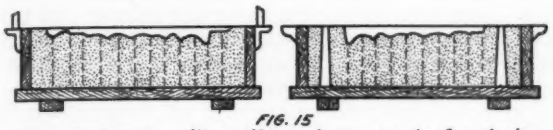

FIG. 15
Drag and cope with pattern drawn ready for closing.

Question Sheet

Molding a split pattern

Directions: This is a multiple-choice test. Underline the correct response (or responses), to each statement.

1. Two advantages of splitting a cylindrical pattern instead of having it solid are: (1) more simple to make the pattern, (2) parting line easily established, (3) pattern will draw better.

2. The best side of the casting would be placed on the (1) drag, (2) cope, (3) cheek.

3. The dowel pins are located on the (1) cope, (2) drag, (3) center.

4. The dowel pins should fit (1) tight, (2) loose, (3) sliding fit.

5. The amount of loose sand placed on the drag flask before rubbing the bottom board in place is (1) one inch, (2) half inch, (3) two inches.

6. The reason for ramming the cope lighter than the drag is to (1) prevent the sand from breaking, (2) make the sand more porous, (3) allow the metal to expand.

7. It is more important to vent the cope than the drag, because (1) gases rise, (2) the sand is stronger, (3) the metal shrinks more evenly.

8. When the flask is taken off the mold before pouring (1) the sand will break, (2) a wooden dummy is slipped on, (3) the gas is allowed to escape.

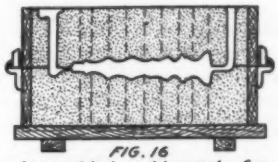

FIG. 16
Assembled mold ready for pouring.

9. The term *back draft* is applied to a pattern with (1) straight sides, (2) draft facing the opposite direction, (3) sand laying on the edge.

10. The most common split pattern is a (1) irregular, (2) cylindrical, (3) master.

11. A dowel pin should protrude from a pattern (1) ¼ inch, (2) the size of the diameter, (3) half the diameter.

Instructor's Remarks:

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Auto Mechanics in the School

H. W. Paine

Associate Professor of Vocational Education, University of Toledo, Toledo, Ohio

What an industrial-arts course in auto mechanics ought to contain, what claims can be made for it, and what it contributes to general education.

IN THEIR zeal to justify individual parts of their school programs, in order to combat the "fad and frill" philosophy of certain false-economy mongers, many have overlooked the responsibility of selling the educational program to the public as an integrated whole, rather than a collection of separately justified parts.

In the following, the writer shows that industrial-arts auto-mechanics courses in cosmopolitan or technical high schools may be truly integral, necessary, and vitally motivating parts of an educational whole. Any attempt to justify elimination of such a course on the "fad and frill" economy basis is an attempt to weaken the whole educational structure. This is really what certain interests are covertly attempting to accomplish to save a few tax dollars for better (?) purposes. The American public is not ready and never will be ready to countenance such a procedure if it is fully acquainted with the facts.

As educators, the industrial-arts auto-mechanics group have erred in not making the real facts regarding the true scope of their subject and its tie-up with other subjects known to the public by charts, graphs, and every other possible means. The accompanying chart attempts to depict a few of these possibilities.

First of all, the status of one- or two-period auto-mechanics courses in a cosmopolitan or technical high school in relation to other aspects of auto-mechanics teaching should be made clear. These industrial-arts courses *are not* and *should not* be made *vocational* in character. Any attempt to disguise their true field by labeling them, misguidedly or otherwise, as "vocational" and carrying them on with vocational objectives only, in mind, detracts from their true value and importance. It harms both industrial arts and true vocational education in the eyes of the public generally and particularly in the eyes of industry.

There are many reasons why these one- or two-period courses cannot be successfully established on a vocational basis. Space does not permit developing them fully. Many of these reasons, however, are self-evident. Lack of shop time;

lack of related-subject teaching provisions; lack of trade background of many industrial-arts teachers, many of whom had educational experience only; and finally lack of placement pos-

sibilities, are a few of the factors that make the true vocational value of these courses practically zero.

Again referring briefly to the chart, the abbreviated listing of the most desirable objectives and possibilities of industrial-arts auto-mechanics courses gives one a glimpse of the tremendous general educational possibilities of this subject. It also gives a hint of the vision, enthusiasm, and general all-round teaching ability needed by the instructor in this field.

Briefly these seven objectives are as follows (no attempt has been made to arrive at an order of importance):

1. Avocational and Leisure Time
2. Intelligent Consumer
3. Work Habits and Safety
4. Motivation and Tie-Up
5. Personality Trait and Ethical Development
6. Citizenship and Social Adjustment
7. Guidance and Exploration

Following the chart through its various divisions, gives one a slight inkling of what can be done with these industrial-arts courses by applying resourcefulness and ingenuity and securing and giving coöperation to the other teachers in the system who handle arithmetic, algebra, geometry, science, physics, chemistry, geography, commerce, industrial history, civics, art and design, bookkeeping, and English. Even the word *automobile* comes from a combination of Greek and Latin words. Why not get the benefits from at least a part of the myriad of possible educational tie-ups suggested in the chart and hundreds of other possibilities that will come to mind?

Methods of attaining these tie-ups could be briefly listed as personal contacts with various instructors furnishing and receiving suggestions from them, group conferences and coöperative efforts, reports, research, and investigation by the students themselves. It is, of course, largely a matter of enthusiasm and salesmanship on the part of the auto-mechanics instructor and will depend upon his personality and the backing he receives from his department head and the principal.

Other portions of the charts dealing with avocational, intelligent consumer, work habits, personality development, citizenship, social adjustment, and guidance and exploration are self-explanatory and indicate the tremendous opportunities of this type of work after one begins to analyze the real possibilities of the course.

Last and most important of all, industrial-arts auto mechanics is not *vocational* with a *specific objective*. It possesses little or no value in this field. It is *general* with a *myriad* of objectives which we must chart and analyze, turning their implications into teaching procedures.

Thus, and only thus, can the greatest possible benefits from these industrial-arts courses be secured. These courses should become motivating forces for the students' entire educational program and should provide the richest and most valuable experience in the student's school career. No other single course in the entire general school curriculum offers greater possibilities or a higher challenge to the teacher in charge.

If the teacher can secure the coöperation of the other teachers in the system to effect his tie-ups and motivation, if he has unlimited enthusiasm, if he knows his subject and has the proper background of trade experience and teaching skill, he will naturally make a splendid success of his job. Conversely, if he cannot secure the coöperation of the other teachers to effect his tie-ups, if he "doesn't care," if he is an academic or woodworking instructor who is merely "pinch-hitting" in auto mechanics without knowledge of or interest in his subject, his course will be a dismal failure and the time the students spend in his classes will be wasted effort or effort worse than wasted.

Problems and Projects

ONE-POUND FUDGE PAN

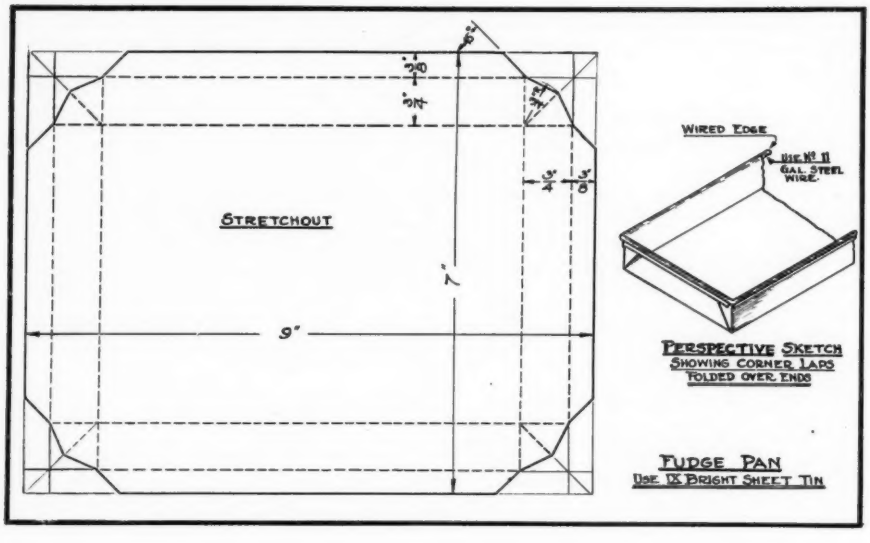
Gerald A. Boate, Seattle, Washington

The fudge pan described herewith is of the leakproof-construction type, i.e., the corners are water-tight although no solder or rivets are used.

The material used is IX tin. This is a real economy project, since a sheet of 20 by 28-in. tin is sufficient for eight pans.

Method of Procedure

1. Make layout on tin, using steel square and scriber.
2. Cut out carefully with straight tinner's snips.
3. Crease the corner diagonals slightly so that the metal will yield when the sides are bent upward. Use a wood mallet (not a steel hammer) if necessary in forming these corners.
4. Make the right-angle bends with the bar folder or over a straight metal or wood corner.
5. Bend the wire hem downward at 90 deg.
6. Fit a piece of No. 11 galvanized steel wire into the wire hem. Butt the ends at the middle of one side.
7. With edge seamer and hammer, bend the hem smoothly over the wire.
8. Form a wire ring and clip. Place ring at center of one edge and bend the clip under the wired edge. Fasten the clip with two small tinner's rivets.



METAL BIRD-CAGE STAND

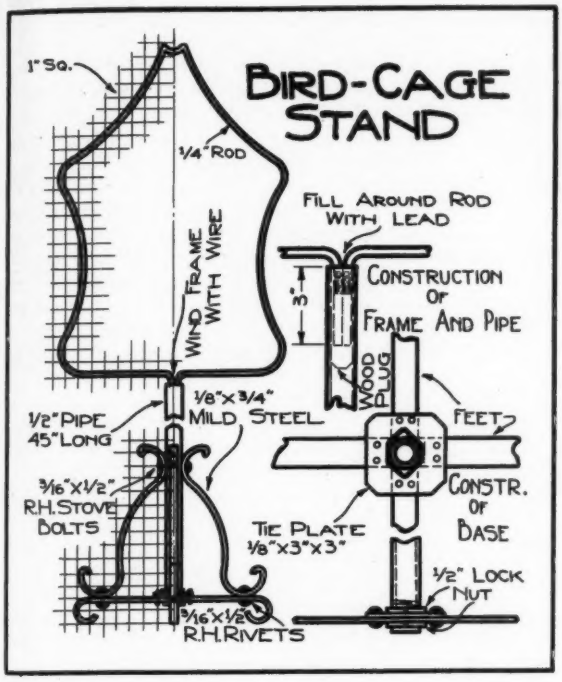
H. O. Jaeger, Moline, Illinois

The bird-cage stand shown here, may be made with ease by an eighth-grade student.

Make a layout of all curved pieces, then obtain the length of each part by placing a piece of string on the layout.

The four feet and four braces are made out of ⅛ by ¾-in. mild steel, the frame is made of ¼-in. rod, and the upright post of a piece of ½-in. pipe. The feet are formed over a piece of pipe or rod of the required diameter. The braces may be formed over a bending form which may be made out of ¼ by 1-in. mild steel.

The tie plate is made of ⅛ by 3 by 3-in. mild steel. The corners are sawed and filed and a hole the size of the pipe is drilled through the center. Locate all holes in feet, braces, and tie plate, and punch or drill 13/64-in. holes to fit bolts and rivets.



Assemble the feet to the tie plate, then the braces to the feet, using ⅛ by ½-in. r.h. rivets.

In shaping the frame, work from the center toward each side. The frame is held together by tying the lower ends of the two rods together with wire. After the wire has been wound around the two ends, hold it in place with solder.

Cut a piece of ½-in. pipe 45 in. long and thread one end for a length of 1½ in. Drive a wooden plug into the other end so that the top of the plug will be about 3 in. from the top of the pipe. Locate the holes in the lower end of the pipe, then drill the 9/64-in. holes, after which they are tapped for 3/16-in. stove bolts.

Place the end of the frame into the upper end of pipe, melt some lead and pour into pipe. This will hold the frame in place.

Obtain two ½-in. lock nuts and turn one on pipe the length of the threads. Place end of pipe through the hole in the tie plate and place the other lock nut beneath.

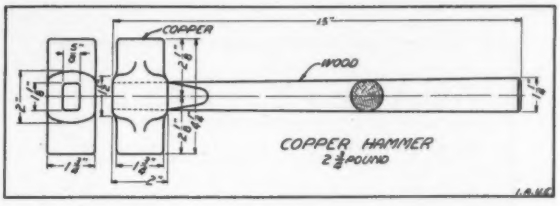
Fasten the braces to the pipe with 3/16 by ½-in. r.h. stove bolts, and then adjust the lock nuts and tighten. Be sure no rough edges are exposed. The stand may then be finished with three coats of lacquer.

COPPER HAMMER

F. N. Newton, Jr., Senior High School, Sharon, Pennsylvania

A copper hammer is a very handy tool in the machine shop, and is not a very difficult tool to make.

The size of the hammer depends on the size of the copper stock secured. The piece of copper is first heated so that it can be pounded out to the proper shape and then the hole for the handle is swedged in by using a piece of tool steel shaped



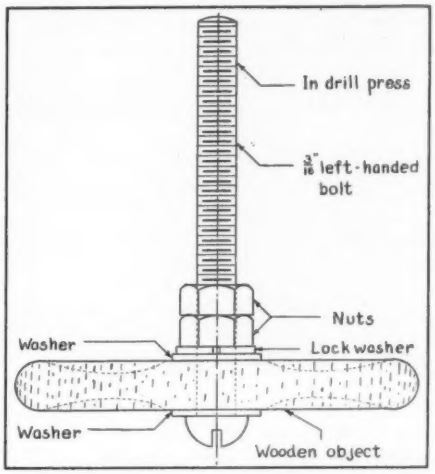
to the proper size, and tapered slightly so it can be driven out without much trouble. This operation is continued until the hole assumes its proper shape and is devoid of ragged edges.

The wooden handle is shaved down to a size slightly larger than the eye of the hammer and driven in, starting from the small end of the eye. After the handle is driven in tightly, the excess part is sawed off with a hacksaw, and a steel wedge is driven into the end of the handle. This swells the wood out so it fills up the eye of the hammer and insures the handle staying in the hammer.

MAKING SMALL AIRPLANE WHEELS

Wilbur E. Getz, East Aurora, Illinois

Small projects, such as balsa airplane wheels, may be readily shaped on the drill press. A left-handed bolt that prevents the loosening of the nut is used, with washers on each side of the object. A lock washer and two nuts hold the object firmly in



place. Sandpaper is used to do the shaping, and because of the high speed, not only is a fast job obtained, but a smooth, neat piece of work, as well. If a left-handed bolt cannot be obtained, put the bolt into the chuck so that the nuts are against the chuck. In this position there will be no tendency for them to loosen up.

SAFETY-FIRST CARDS

K. L. Dragoo, Smith-Hughes Machine Shop, Rock Springs, Wyoming

Safety First is one of the shop instructor's chief problems. To combat the criticism of safety-first men from various mining companies and from the railroad, the card shown herewith was devised for use in the Rock Springs High School machine shop.

From two to ten minutes daily are taken for a short talk on the safe use of machines, tools, etc. At the end of the first month a short written test is given covering all points pertaining to safety first in each shop. The card shown is then passed out for signing. Each boy is warned to read the card carefully before signing it. The cards are filed by classes for reference.

If a boy has an accident, the class is called to order, the wound, if any, is taken care of from the medicine kit, and then

::SAFETY FIRST::

ROCK SPRINGS HIGH SCHOOL

I_____PLEDGE

myself to obey all of the safety first rules of this shop, and if I am ever in doubt about any rule I will consult the instructor or reference lists.

the accident is discussed. Then the boy's card is brought out and he is required to write a report of the accident, and how it might have been prevented, before he is permitted to resume work.

A boy having an accident and going through this process seldom makes the same mistake twice, and the accident rarely will happen to any other member of the class. An irate parent can be cooled by showing him the safety-first cards, the signs over the machines, and the lecture material that is used.

This simple device will help many evade suffering, time and wage losses, unpleasant interviews, and perhaps dismissal because of inattention to safety-first rules.

ARCHITECTURAL DRAWING
Test No. 5
Scoring Sheet

Ren Aton, Michigan City, Indiana

(See Supplement No. 298)

1. Chimney cap	11. Ash-dump cleanout
2. Flashing	12. Cricket
3. Mantel	13. Rafter
4. Throat and damper	14. Firestopping
5. Angle iron	15. Base
6. Fire brick	16. Finish floor
7. Niche	17. Floor joist
8. Brick hearth	18. Firestopping
9. Header beam	19. Ash pit
10. Trimmer arch	20. Footing

AN ALUMINUM TRAY

Murray V. Churchill, Pittsburgh, Pennsylvania

To make the aluminum tray shown in Figure 1, mark the outline of the shape of tray desired with a scriber and straightedge on aluminum 1/16 in. thick. Cut out the metal close to the mark, but a trifle outside. A hacksaw or a jeweler's saw may be used for doing this. Then with a marking gauge or straightedge and scriber, mark the line where the sinkage of the tray will begin. The most important tools used in shaping the aluminum are a vise, a hammer, and several chasing tools. The vise may be an ordinary machinist's vise, preferably with a large anvil surface, which should be smooth and unscarred. If it has knurled jaws, it will have to be fitted with safety jaws to avoid scarring the metal. The safety jaws are nothing more than two thin sheets of aluminum or hard lead, but about 1 in. larger than the jaw faces, and bent at the top and on the sides so as to hang between the jaws when the vise is open.

Use a hammer of the ball-peen type, of medium size. The face of the ball end should be bright and smooth and free from scars, so as to leave an even shiny mark. The chasing tools are rods made of tool steel with rounded ends. Although you can get along with one of them, which should be ⅜ in. in diameter, you can do a better job if you have several smaller ones for finishing the sinking of the metal close to the edges and in the corners.

Take the cut sheet of metal and clamp it upright in the vise, so that the inside border line is slightly above the top of the jaw, as shown in Figure 2. Using the ⅜-in. chasing tool and the hammer, beat in the bottom of the tray to the required depth, say ¼ in., all around the edge, being careful not to overstep the border line. Sharper edges and corners can be made if you finish the sinkage with the smaller chasing tool. Of course, when you have finished with the portion immediately above the vise, you move the tray on to the next position. It is usually well to let the successive positions of the vise overlap, since hammer strokes too close to either side of the jaws are likely to bend the tray out of shape.

After you have completed sinking the tray bottom, remove the tray from the vise and lay it on a metal surface. In this connection, it is a curious fact that when you hand anyone a handmade article, the first thing they do is to turn it over and look at the bottom. If you want a wrought effect that looks a thousand years old, set the tray on a sheet of aluminum or hard lead. Smoking the aluminum before peening will enhance this appearance. Start peening the bottom of the tray all over, beginning near the edge, and working round and round toward the center with close overlapping strokes. To make the best appearance, make the strokes close enough so there are no "landings," that is, spaces between peen marks that have not themselves been peened. It will perhaps be a good idea to go over the surface a second time, going round in the opposite direction. Perhaps the only way to describe the appearance of a well-peened bright surface is to compare it to that of a well-filled dish of soap suds. Your eye will tell you whether you have made all parts of the tray match.

If instead of the wavy, ancient appearance of the underside, you wish it to look just like the top, there is a little attachment you can obtain to fit in the cutter hole of your vise. It is in effect a second ball peen which puts a peen mark on the underside of the tray to correspond with every one you put in the top. To use this device, you have to move your tray with every stroke, so that the anvil will be directly under the hammer.

If you want to add a final touch of distinction, in the shape of a raised monogram plate in the center, simply omit beating in that spot, which of course, as a skilled mechanic, you have outlined with your scriber. The edge of this can be worked in with a small round-edged graver held crosswise to the line. About 40 graver marks to the inch makes a good-looking border.

You will probably notice at this point that the bottom of the tray is somewhat dished in from the peening operation, and, incidentally, you may also observe that it is somewhat stiffer from the cold working. To straighten the tray, turn it upside down on a firm level surface (this should be aluminum or hard lead to avoid marring the plain raised rim) and beat it with a rawhide mallet as shown in Figure 4. Do not use a metal hammer for this part of the work. It may be necessary to repeat this operation several times, reversing the tray, until it is properly straightened. Trim off the sawed edges to the line with a file, and then the tray is ready to be polished.

For polishing, you will need a buffing wheel about 6 in. in diameter which is made of stitched linen disks; some Lea's greaseless polishing compound; and, if a bright finish is required, some lime polish. Put a little of the coarser Lea's compound on the buffing wheel, start it, and hold the tray steadily but not too hard against it. Keep moving the tray so that all parts of it become polished evenly. If you finish off the polish carefully enough with the finest grade of Lea's compound, you will have a fine-looking dull finish. But to make the tray sparkle like a mirror, give it a final polishing with lime polish.

This tray is an ideal first project, as it is relatively simple. After the one shown has been acceptably finished, other trays of varying shapes may be attempted.

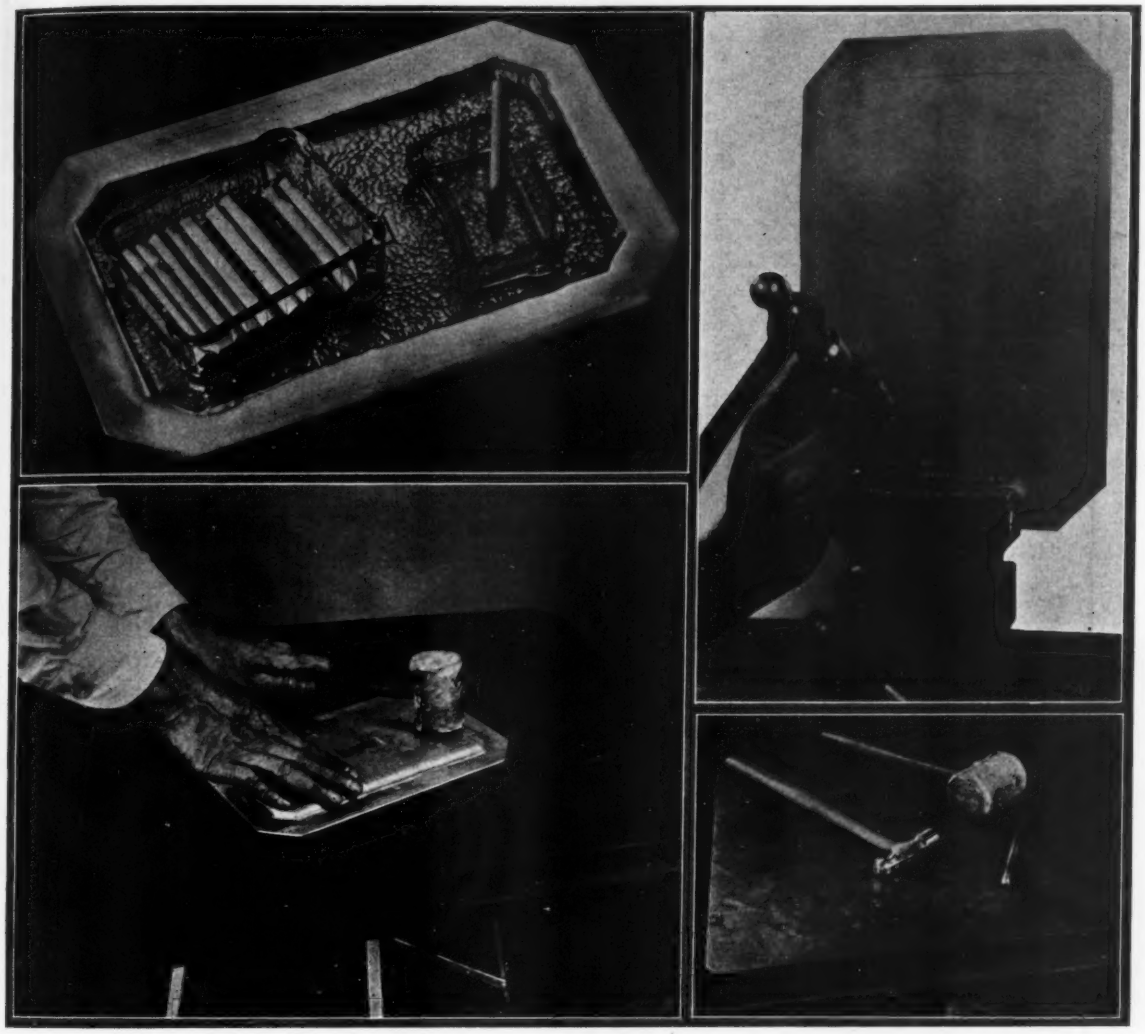


Fig. 1. The finished tray may also be used as a card tray or a serving tray. Fig. 2. The first step in the forming of the tray. Be sure to use safety jaws on the vise to avoid scarring the metal. Do not strike any blows beyond the sides of the vise. Fig. 3. The tools used in making the tray: a ball-peen hammer, a rawhide mallet, facing tools, and a metal-top or hardwood table on which to work. Fig. 4. Straightening the tray after peening. To flatten it out correctly may necessitate turning it and striking it with the mallet on the other side. Repeat these operations until the tray will sit without rocking on a flat surface

SOLVING THE DUST PROBLEM IN THE FINISHING ROOM

Tom S. Jenkins, Ames, Iowa

In forty finishing rooms that have been visited during the past few months, instructors all complained about the *dust* problem.

The vexing question was solved successfully, however, at Redfield, South Dakota, by the use of a cabinet as a drying room. This cabinet covers the entire width of one end of the finishing room. It is deep enough to accommodate a cedar chest or a davenport table. It is divided vertically into three sections with two sliding doors for each. Ample ventilation is provided by a 3-in. transom at the top and bottom of each of the doors. These openings are covered with muslin, the bottom ones also being protected by a wire screen of heavy mesh. The shelves in the cabinet are made in the form of grates, with ½-in. openings between the strips. These grates are removable and adjustable.

The cabinet is easily cleaned. In addition to controlling the dust problem, it also adds materially in eliminating finger marks from the finished surfaces.

JUNIOR SPEED BOAT

Armand J. La Berge, Bryant Junior High School, Minneapolis, Minnesota

The junior speed boat described herewith is an ideal problem for beginning classes in woodwork. It does not require much material and yet offers a variety and combination of materials and processes that make it most appropriate to the junior-high-school shop.

A model motor boat is a project that every boy likes to make. He will not only produce a presentable boat, but he will master the essential tool processes and related information with little effort, because he is producing something in which he is thoroughly interested.

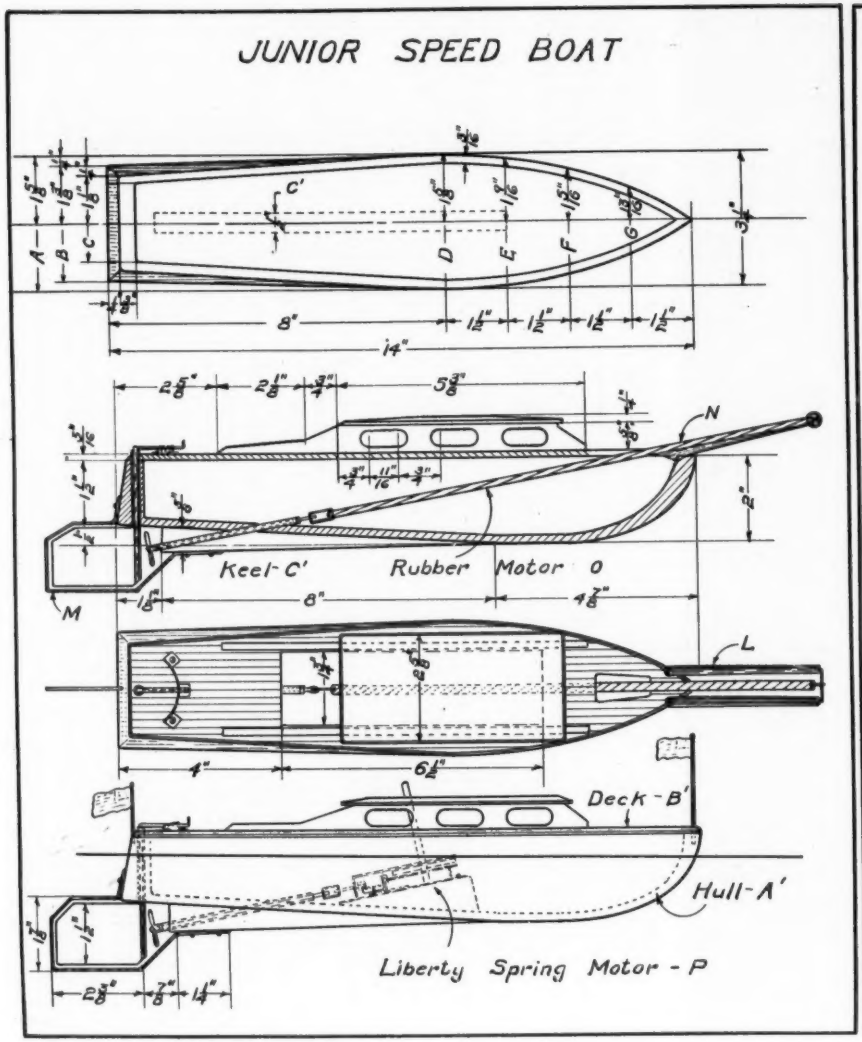

JUNIOR SPEED BOAT
Keel-C'
Rubber Motor O
Deck-B'
Hull-A'
Liberty Spring Motor - P

Fig. 7

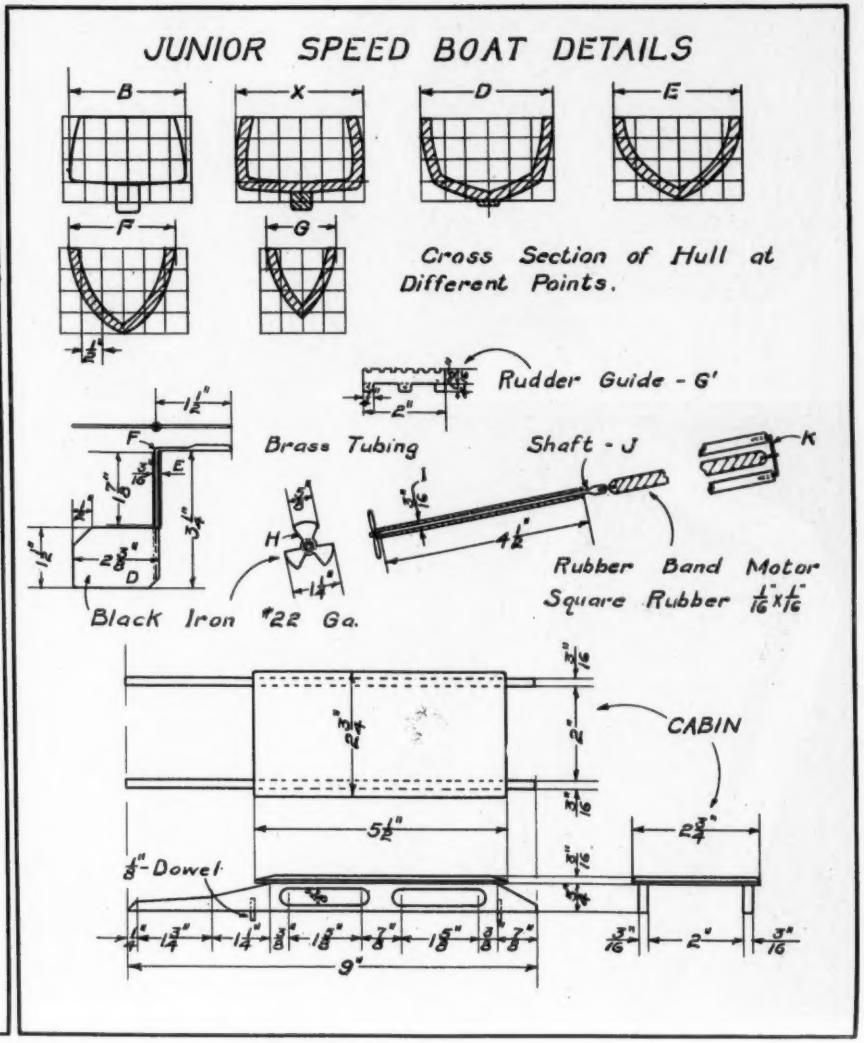
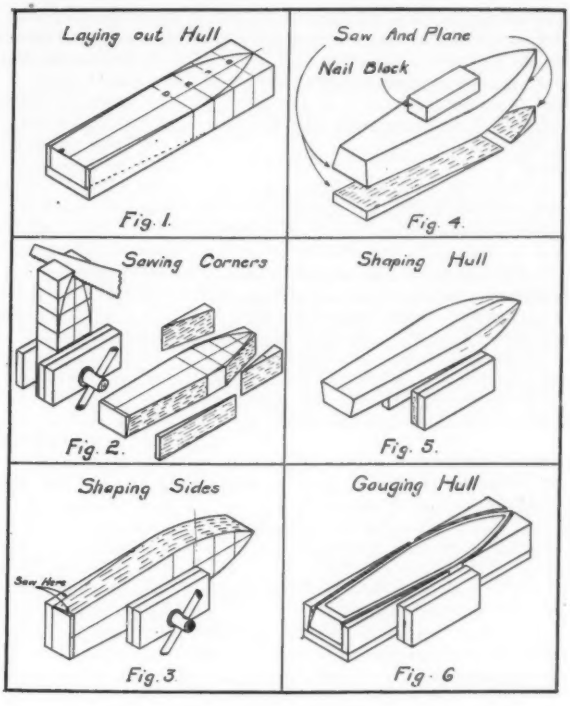

JUNIOR SPEED BOAT DETAILS
Cross Section of Hull at Different Points.
Rudder Guide - G'
Brass Tubing
Shaft - J
Rubber Band Motor
Square Rubber 1/16" x 1/16"
Black Iron #22 Ga.
CABIN
3/8"-Dowel

Fig. 8

1 pc. 2" x 3¼" x 14"	pine.	Hull (A)
1 pc. 3/16" x 3¼" x 14"	red gum.	Deck (B)
1 pc. ½" x ¾" x 8"	pine.	Keel (C)
1 pc. 1½" x 2¾"	black iron, No. 22 gauge.	Rudder (D)
1 pc. 3/16" x 1⅞"	brass tubing.	Rudder Port (E)
1 pc. ⅛" x 4¾"	brass rod.	Rudder Rod and Tiller (F)
1 pc. 9/16" x 2"	black iron, No. 26 gauge.	Rudder Guide (G)
1 pc. 1¼" x 1¼"	black iron, No. 22 gauge.	Propellor (H)
1 pc. 3/16" x 4½"	brass tubing.	Propellor Shaft Tubing (I)
1 pc. ⅛" x 5½"	brass rod.	Propellor Shaft (J)
1 pc.	brass wire.	Brace (K)
2 pc. 5/16" x 6"	red-gum dowels.	Dowel Cannons (L)
1 pc.	radio square wire.	Rudder Guard (M)
4 yds. 1/16" x 1/16"	square rubber.	Rubber Motor (N)
1	motor with propellor and shaft.	Liberty or Spring Motor
2 pc. 3/16" x ¾" x 9"	red gum.	Cabin
1 pc. 3/16" x 2¾" x 5½"	red gum.	



Procedure

1. Take a piece of white pine and square it to the finished dimensions 2 by 3¼ by 14 in.

2. Lay out the hull as shown in Figure 1 according to the dimensions given in Figure 7.

3. Use a pair of dividers and a rule in measuring and spacing on each division line B, D, E, F, and G.

4. Saw the corners and the lower part of the hull block as shown in Figures 2 and 3.

5. With a spokeshave, shape the sides of the hull as shown in Figure 3.

6. Nail a block to the top of the hull as shown in Figure 4. The hull can then be held securely in the vise while shaping the outside.

7. The shaping of the hull is a very important part of the job. Do not rush the work at this point, but take plenty of time.

8. Use a spokeshave when shaping the outside part of the hull. See Figure 5.

9. Check the hull often with the cross sections shown in Figure 8.

10. Make a cradle to hold the hull, while carving the inside part of the boat. The corners sawed from the rough hull block fastened to a rough board can be used for the cradle (see Fig. 6). The hull can be held in a vise quite satisfactorily without the cradle, but a device of this kind helps to make the work easier.

11. With a ¾-in. gouge and a mallet, gouge out the inside of the hull until the walls are about 3/16 in. in thickness, except at the stern and the bow of the boat.

12. Sandpaper the inside part of the hull with fine sandpaper. Make it as smooth as possible.

13. Give the inside part of the hull one or two coats of spar varnish, in order to waterproof it thoroughly.

Keel

1. Make the keel C, Figure 7, out of a piece of pine ½ by ¾ by 8 in.

2. Fasten the keel to the hull with glue and brads. The keel should be fastened at the center of the hull 1⅛ in. from the back of the boat.

3. Bore a hole in the keel and in the bottom of the boat to receive the shaft tubing. The size of the hole will depend on the size of the tubing. The rubber motor will take a 3/16-in. diameter tubing. The tubing that comes with a Liberty spring motor is 5732 in. in diameter.

Cannon Braces

1. Use two 5/16 by 6-in. dowels for the cannon effects shown at L in Figure 7. The purpose of these braces is to allow more room and power when using a rubber motor.

2. Bore 5/16-in. holes to receive these cannon braces. Place them ⅝ in. apart leaving enough room for the rubber motor to work freely. Line up the cannons with the propellor-shaft tubing.

3. Make brace K, Figure 7, from wire, and insert in the ends of cannon braces, as shown.

Propellor and Rubber Motor

1. Make the propellor of No. 22 black iron. Follow the detail in Figure 8.

2. Drill a ⅛-in. hole at the center of the propellor and solder it to one end of the ⅛ by 5½-in. brass propellor shaft J, Figure 8.

3. Make the propellor-shaft bearing I out of a piece of 3/16-in. brass tubing, 4½ in. long.

4. Insert a bushing 1/16 in. in thickness between the propellor and tube bearing I. The bushing may be cut off a piece of 3/16-in. brass tubing.

5. A bushing should also be placed on the other end of the shaft between the bearing and the flattened part of the shaft (see Fig. 8).

6. Insert the propellor shaft J in the tube bearing I and flatten the top end of the shaft in a vise or with a hammer.

7. Bore a 1/32-in. hole through the flat end of the shaft to receive the hook for the rubber motor.

8. The tube bearing I with propellor shaft can next be inserted in the 3/16-in. hole in the keel and boat. Cement the tube in place with ship cement or ambroid.

9. The square rubber should then be attached to the shaft and cannon braces next.

*Spring Motor**

There are some very inexpensive spring motors on the market, which are ideal for motor boats of this type. The propellor shaft and tubing bearing come with the motor.

In our annual model-boat races we had fifty model boats of the junior type propelled by spring motors.

If a spring motor is used, place and adjust the motor before fastening the deck to the boat.

Deck and Cabin

1. The deck for the junior speed boat can be made of red gum or butternut or some other contrasting wood.

2. Shape the deck of a piece of wood ¼ by 3½ by 14½ in. according to the top shape of your boat.

3. Cut out the hatchway 1¾ by 6½ in., and 4 in. from the back of the deck, with a coping saw.

4. Give the underpart of the deck B a coat of varnish and fasten the deck to the hull with glue and ⅝-in. brads. Place the brads about 1¼ in. apart.

5. The deck should have a curved top from 3/16 in. in thickness at the center,

*Addresses of manufacturers of spring motors will be given on application.

rounded to 1/16 in. in thickness at the sides and ends. This can best be done by planing the top part of the deck with a block plane or a smooth plane, while the boat is held in a vise.

6. Fill all nail holes with filler the color of the deck.

Cabin

1. Make the cabin next. Square the sidepieces to the finished dimensions 3/16 by ¾ by 9 in. and the top 3/16 by 2¾ by 5½ in.

2. Cut out the window openings with a coping saw, boring a ⅛-in. hole at the end of each window with a sharp bit first.

3. Insert four ⅛-in. dowels in the bottom of the sidepieces. Bore holes in the deck at the right places to receive the dowels of the cabin. In this manner, the cabin can be removed from the boat at any time.

Rudder and Guide

1. Make the rudder D from a piece of No. 22 black iron, 1½ by 2¾ in.

2. Turn one edge with the wiring machine or a pair of pliers and solder to a piece of ⅛ by 4¾-in. brass rod.

3. Cut the rudder port E out of a piece of 3/16-in. brass tubing.

4. Bore a 3/16-in. hole through the back of the hull ¼ in. from the back of the hull at a center point.

5. Insert and cement the tube port E in the 3/16-in. hole.

6. Insert the brass rod F part of the rudder in the port E and bend the rod to form the tiller, as shown in the detail drawing.

7. Flatten the end of the tiller to fit in the rudder guide.

8. Make the rudder guide G from a piece of metal, as shown in the detail drawing.

9. Make the propellor and rudder guard of 1/16-in. square wire and flatten both ends of the wire with a hammer. Drill 1/16-in. holes in the flat part of the wire.

10. Shape and fasten the guard to the back of the boat and the keel with small brass screws.

Finishing with Paint and Enamel

1. Do the finishing in a dry room at about 70 deg. F.

2. Prepare the surface of the hull to be finished carefully.

3. Check the surface and make sure that all tool marks, chipped grain, and surplus glue are entirely removed.

4. Sand the boat first with No. 0 sandpaper and finish with 4/0 sandpaper.

5. Dust off the hull carefully so it will be absolutely free of dust before painting.

6. Use a ready-mixed paint for the undercoat. Thin it down to the consistency of cream by adding a few drops of japan dryer to a half pint of paint. The best paint for water protection is pure white lead.

7. Apply two or three coats of ready-mixed paint or white lead, rubbing each down with 4/0 sandpaper. Each coat should be allowed to dry at least 24 hours before sanding.

Apply the Enamel

1. Make sure the surface of the hull is absolutely smooth and free of dust before applying the enamel.

2. Enamel is more expensive than paint for the final finish, but it makes a very desirable finish for model boats due to its wearing qualities and fine appearance. Enamel may be purchased in small quantities on the market in almost any color.

3. Apply a first coat of enamel with a good brush. A camel's-hair brush ½ in. wide works very well on this size of boat.

4. Flow and brush this first coat on evenly. Allow the enamel to dry for at least 24 hours.

5. When dry, remove all gloss and rough spots with 4/0 sandpaper by sanding very lightly. Be careful not to rub through the enamel.

6. Dust off the surface thoroughly and apply a second coat of enamel as it comes from the container.

7. With fine pumice stone and oil, rub and polish the outside of the hull to a high polish and luster.

8. Finish the deck and cabin natural.

9. Use a thin coat of white shellac on the deck and cabin as an undercoat or as a filler for the varnish.

10. Sand the white shellac lightly with the grain with 4/0 sandpaper.

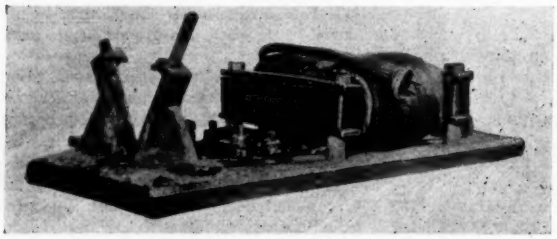
11. Apply one or two coats of spar varnish or some very good outside varnish to the deck and cabin as a final finish.

ELECTRIC SOLDERING-IRON HEATER

R. H. Ingersoll, Polytechnic High School, Riverside, California

The soldering-iron heater described and illustrated herewith, was built and used in our electric shop. It has been in steady use for over two years without giving any trouble. Another one, made for a school shop in a near-by town, also has proved very satisfactory.

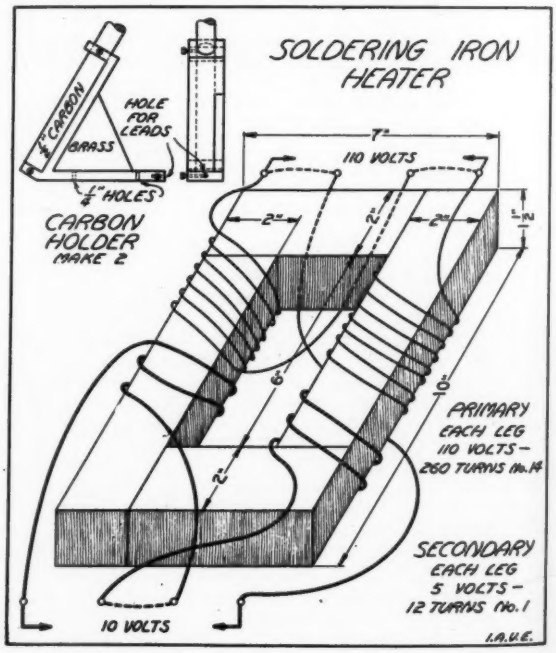
While its primary purpose is to heat soldering coppers, it can



be used to draw the temper of small pieces of steel, heat soldering lugs, and demonstrate the fusing currents necessary for different materials.

It is constructed as follows: The transformer is of the standard core type made from salvaged transformer iron. The core should have a cross-section area of about 3 sq. in. with an internal window about 3 by 6 in. Each leg has a 110-volt primary winding consisting of 260 turns of No. 14 dcc wire. The secondary windings are wound on top of the primary windings, one on each leg, and consist of 12 turns of 4 pieces of 1/16 by ¼-in. strap copper wire taped together as one wire. It would be permissible to use any wire having about the same area (84,000 cm.) or No. 1 B&S gauge. Paralleling the 4 or more wires makes the coil easier to wind and it usually is easier to obtain the smaller wire.

Both primary and secondary leads are brought out to the terminals so that they may be connected (primary parallel — 110 volts, series — 220 volts; secondary parallel — 6 volts, series—12 volts).



The carbon holders are made of brass or copper and are designed to hold a standard ½-in. carbon at 60 deg. from the base, or in other words the two carbons have an inclined angle of 60 deg. We use short-used carbons secured from blue-printing establishments.

Figure 2 shows only one of the many ways in which such an outfit may be mounted. We have in one case placed the

transformer under the table with the carbon holder mounted above the table. Then with the primary leads connected properly to a double-pole, double-throw switch, and 110-volt power supply, the switch in one position connects the coils in parallel giving a high current for fast heating, and in the other position puts the coils in series giving a lower current to keep the iron hot.

EXPLAINING THIRD-BRUSH VOLTAGE REGULATION IN AUTOMOBILE GENERATORS

Wynne L. McDougal, The Pullman Free School of Manual Training, Chicago, Illinois

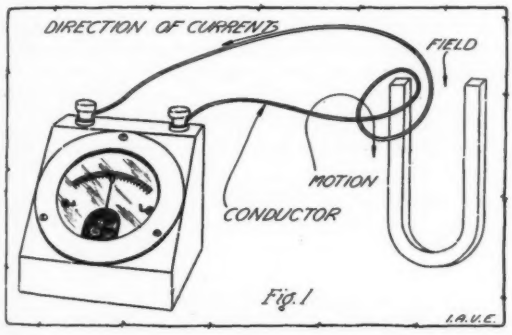
The simple teaching device described herewith was made to clear up the theory of the modern automobile generator's voltage regulation in the mind of the average student.

It is well to preface all generator instruction with a lecture-table demonstration of the results obtained by moving a wire in a magnetic field. The apparatus shown in Figure 1 is suggested for this simple experiment.

It is well, also, to tie up definitely the comparison of magnetic force-lines to the action of stretched rubber bands. An attempt by the student to withdraw an iron core from an energized solenoid will show him the similarity in the "feel" between the two. Also magnets and iron filings are deemed essential.

The automobile generator is a simple electrical machine of the ordinary shunt-generator type.

To show the need of some form of voltage regulation, it is necessary only to call attention to the fact that an automobile generator being driven at constantly varying speeds will deliver voltages varying with these speeds unless there is a provision made to regulate or hold it at some constant voltage regardless of the generator speed.



In the talk on regulation, or automatic control, it is well to dwell briefly on the vibrating-relay method used in the earlier steps of the generator's commercial development. It will help to show that regulation is procured through the control of field voltages.

Then dwell upon the marvelous ingenuity which brought out the perfect regulation furnished by the third-brush system; call attention to the absence of moving parts, the ease of adjustment, and the perfect reliability of this device.

Having built up this background, make use of the teaching device described in this article to show at a glance the critical action of this regulation, which many have found so hard to explain with blackboard and crayon.

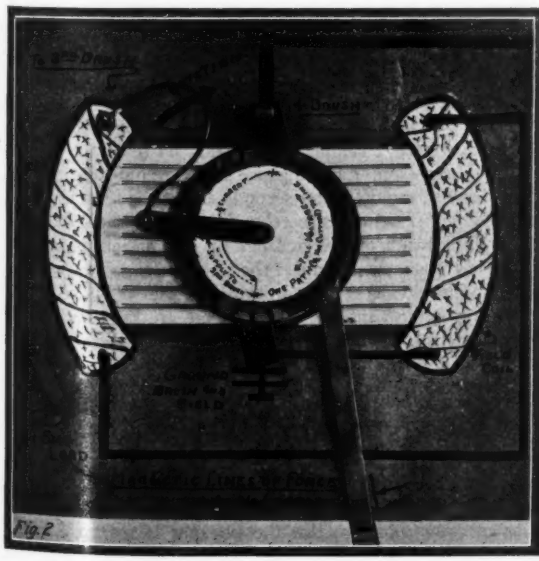
The device shown in Figure 2 is perhaps a foot square. It is constructed on beaver board and painted in colors with lacquer.

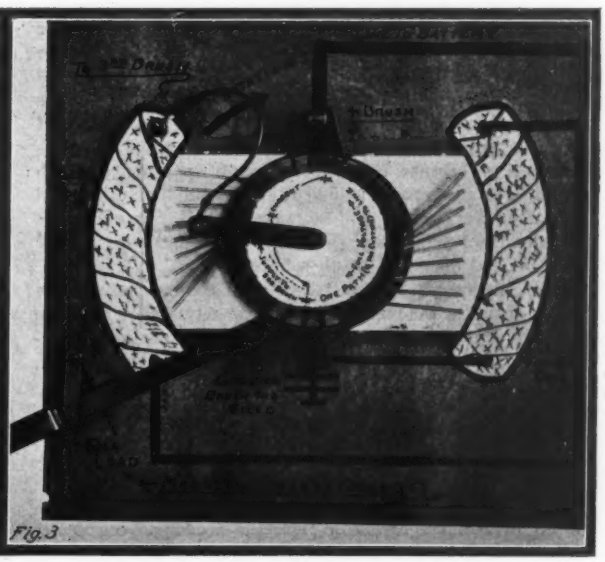
The wiring and field coils are painted on the beaver board. The pole pieces are of thin sheet brass to which are soldered the escutcheon pins. The latter are to hold in place the rubber bands representing the lines of force. The commutator and two main brushes are cut as one piece from a similar brass plate and painted as shown. Beneath this commutator is a brass plate carrying a double row of escutcheon pins which, upon the movement of the extending lever, gives to these rubber bands an action similar to the distortion of the lines of force of an actual generator at full, or at an intermediate load. Figure 3 shows the resultant field. The lock shown in Figures 2 and 3 was found necessary to hold the disk in position during the photographic process. The third brush, being adjustable, is brought as an arm over the top of the commutator to the center; the part from the edge of the commutator to the center post may be painted to make it more obscure.

The diagram shows that the fields are energized by the current collected from those commutator bars which lie between the negative, or grounded brush and the third brush, which is positive. *No other part of the armature furnishes any current for this field circuit.*

Current from a point at the grounded brush flows each way through both halves of the armature and is collected by the main positive brush. This is the line current carried to the battery.

Voltage regulation is effected by an increase in the generator load; this load is increased not by adding more devices

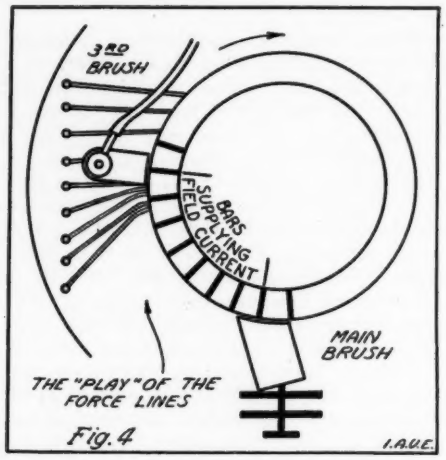




to the circuit, but by an increase in engine speed, which raises the voltage and consequently forces a greater amount of current through the line. *The current makes the load.*

The greater the load becomes, the more distorted is the field, and at full load it assumes a shape as shown in Figure 3. In this figure it will be noted that the lines of force are practically cleared from the space between the third and the grounded brush. When this is the condition, then there are no lines lying there to be cut by conductors, *and no current is then furnished to the field.* Because then the field is not supplying any lines of force, the line voltage is instantly reduced, making the field again like that shown in Figure 2.

The fluctuations are not across the entire range, however, but actually some point is reached in this scheme of things, where just enough lines of force are maintained in this area to hold a proper balance — which means, of course, the proper voltage. Figure 4 shows this area.



This voltage is adjustable. Moving the third brush in the direction of armature rotation takes in more lines of force and the generator voltage is raised; moving it against the rotation takes in fewer lines of force and the generator voltage is lowered. If the load is removed from the generator, the third brush is thrown entirely out of control and seriously high generator voltages are the result. Then lamps may be burned out, paste loosened in the plates of the battery, and enough current generated to ruin the commutator and armature windings.

The diagram used here is that of a two-pole machine for simplicity's sake. Early in the development of the generator it was found that four-pole machines could better care for the loads. Two-pole machines have lap-wound armatures, and the use of a lap-wound armature in a four-pole machine (unless complicated cross connections are employed in the winding of the armature) would demand the use of four main brushes and two third brushes. Because of a lack of space on the brush ring, and the accompanying difficulties in insulation, this would be next to impossible. And so wave-wound armatures were generally employed, since with the wave-wound type all but two main and one third brush can be omitted.

As engine speeds have increased with the new automobile designs, many of the manufacturers have returned to two-pole types. If free wheeling were to continue popular and be retained in future designs, four-pole generators would, no doubt, again predominate.

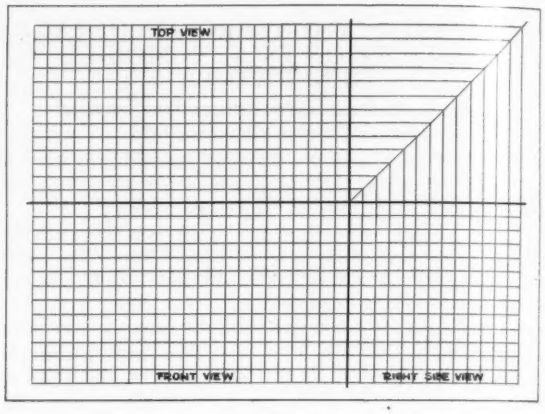
DEVICE FOR TEACHING ORTHOGRAPHIC PROJECTION

O. C. Nelson, Milwaukee, Wisconsin

For the boy who finds it difficult to grasp the method employed in orthographic projection, the accompanying device will prove a helpful timesaver.

The heavy vertical and horizontal lines represent the usual profile and horizontal planes, respectively. The paper on which the drawing is made, being the *vertical* plane. The ¼-in. squares are in projection in the various views.

In use, the *projection sheet* is tacked on a small drawing board (or 9 by 12-in. clip board) and a light-weight typewriter



paper, or "onion skin" second sheet, is tacked over it. The boy is given a dimensioned "picture drawing" of a cut-block or some simple object, and allowed to draw the required three views free-hand. The views are easily blocked out, and correctly projected without the use of confusing instruments. Several three-view drawings can easily be completed in much less time than is required for one drawing, using T-square and triangles.

When the pupil understands the method used in projection, he can then devote his time to the acquisition of skill and proficiency in the use of instruments.

THE SINE BAR

J. C. Wagner, Technical High School, Brooklyn, New York

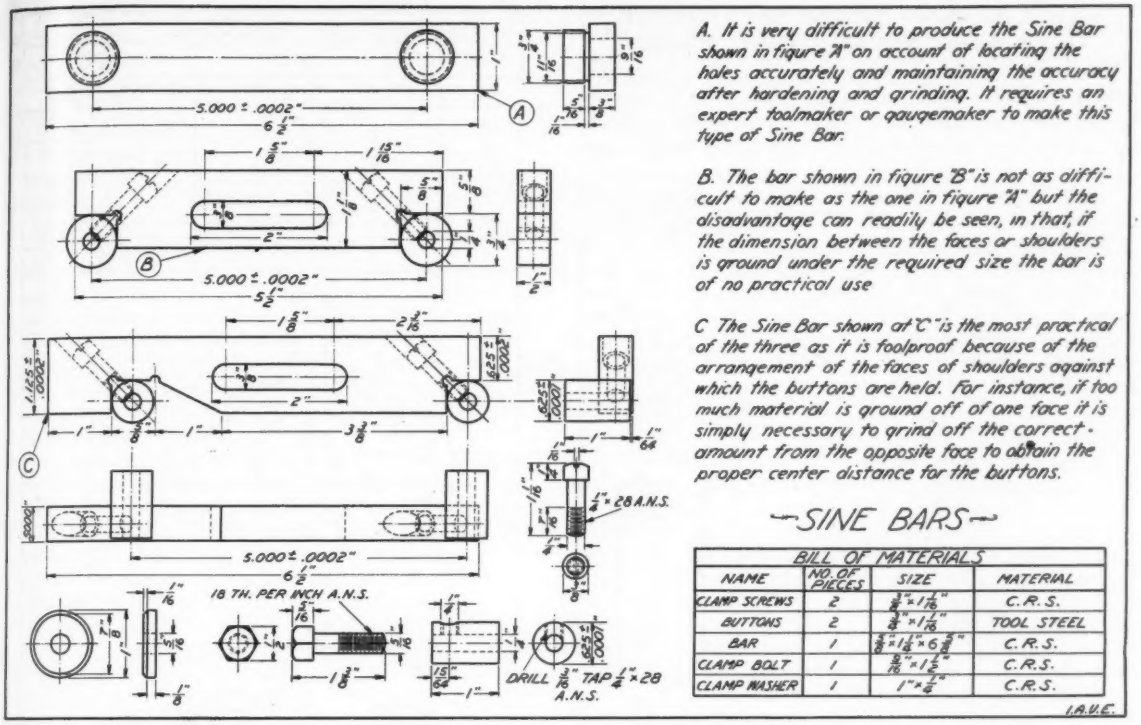
In every machine shop there is more or less difficulty in laying out, setting up, and checking angles accurately. With a knowledge of the natural functions of trigonometry and the proper use of the device known as the *sine bar,* however, this type of work may be simplified. The *sine bar* is invaluable in the toolrooms and inspection departments of companies manufacturing automobiles, airplane engines, airplane instruments, guns, and other types of precision work.

The bar is frequently set up with a veneer height gauge and indicator so that readings may be taken by passing the indicator point over the top of the disks or buttons. As the height gauge reads in the thousandths of an inch it can be readily seen that this method is not very accurate, especially when the workman has to trust to the eye alone. However, by actual experience it has been found that by using the sine bar with the Johansson or Hoke gauge blocks, an angle can be set up to degrees, minutes, and seconds. The gauge blocks should be placed under the disks thereby giving a positive set-up.

The application of the sine bar to shop problems is based on the trigonometric formula: the sine of the angle equals the side opposite divided by the hypotenuse, that is, if the lengths of the hypotenuse and the side opposite are known, the angle can be determined. The result of this division having been obtained, the required angle in degrees and minutes can be found by reference to a table of natural trigonometric functions.

Figure 1 shows a sine-bar set-up of 30 degrees and a series of right-angled triangles having a common angle at 0, and hypotenuses 1 in., 2 in., 3 in., 4 in., and 5 in. long. From the drawing it will readily be seen that the side 2B is twice the length of 1A and that the side of 5E is five times the length of 1A.

In machine-shop practice the sine bar is set up to represent the hypotenuse of the right triangle, and from the above



A. It is very difficult to produce the Sine Bar shown in figure "A" on account of locating the holes accurately and maintaining the accuracy after hardening and grinding. It requires an expert toolmaker or gaugemaker to make this type of Sine Bar.

B. The bar shown in figure "B" is not as difficult to make as the one in figure "A" but the disadvantage can readily be seen, in that, if the dimension between the faces or shoulders is ground under the required size the bar is of no practical use

C The Sine Bar shown at "C" is the most practical of the three as it is foolproof because of the arrangement of the faces of shoulders against which the buttons are held. For instance, if too much material is ground off of one face it is simply necessary to grind off the correct amount from the opposite face to obtain the proper center distance for the buttons.

SINE BARS

BILL OF MATERIALS

NAME	NO. OF PIECES	SIZE	MATERIAL
CLAMP SCREWS	2	3/8" × 1 1/16"	C.R.S.
BUTTONS	2	3/8" × 1 1/16"	TOOL STEEL
BAR	1	5/8" × 1 1/4" × 6 3/4"	C.R.S.
CLAMP BOLT	1	5/16" × 1 1/2"	C.R.S.
CLAMP WASHER	1	1" × 3/8"	C.R.S.

I.A.V.E.

explanation it will be observed that when using a 5-in. sine bar, it is necessary to multiply the figures taken from the sine table by 5. When using a 10-in. sine bar, multiply by 10. The result obtained by this multiplication represents the difference in height between the buttons on the sine bar.

To illustrate the accuracy of a sine-bar set-up, assume that a 5-in. sine bar is accurate within .0002. That would mean that on a tool or gauge 1 in. long, the error would be only .00004 in. If a 10-in. sine bar of the same accuracy were used, then the error would be one half or .00002 of an inch. How small this error is may be realized when one remembers that human hair is .003 in. thick.

The sine bar becomes a very good project in the last term of machine-shop practice in a technical high school, as it can be related readily with the studies in mathematics and science courses. It can be used as a visual aid by actual demonstration in the trigonometry class showing the practical application with reference to the tables of natural trigonometric functions.

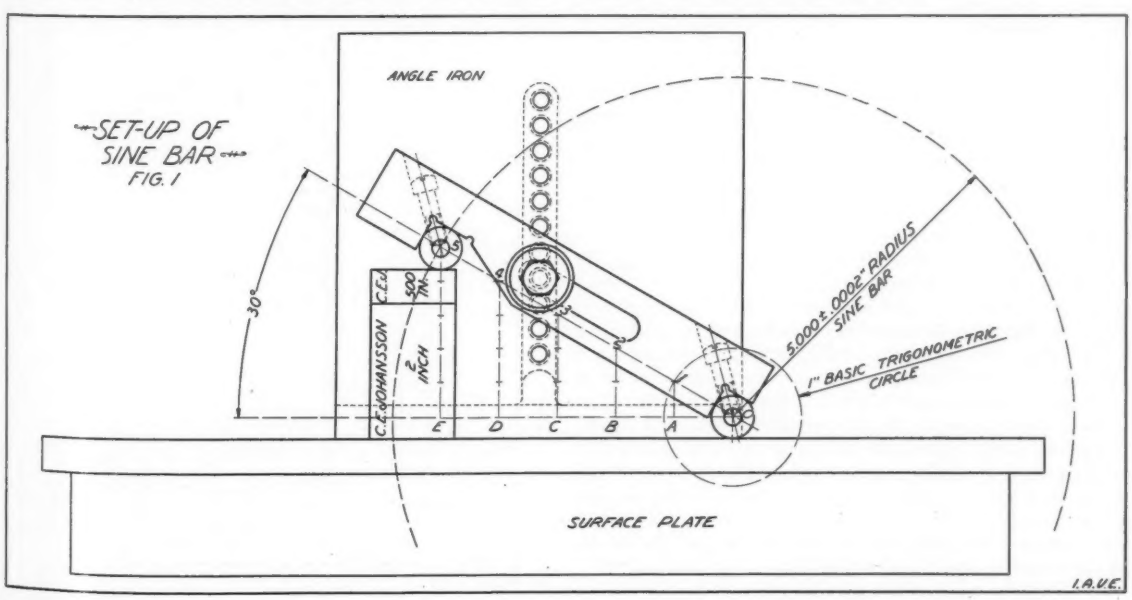
ETCHING SOLUTIONS

For Brass: Dissolve 1 part of potassium chlorate in 20 parts of water. Mix separately 3 parts of nitric acid with 30 parts of water. Then mix the two solutions, allow the gases to escape, stir the solution once more and it is ready for use.

For Copper: Mix 2 parts nitric acid with 1 part of sulphuric acid.

For Steel: Mix 2 parts nitric acid with 1 part acetic acid (strong vinegar).

Cleanliness is a prime requisite for etching. Have the metal clean before applying the resist. Be especially careful that there is no oil or grease on the metal.

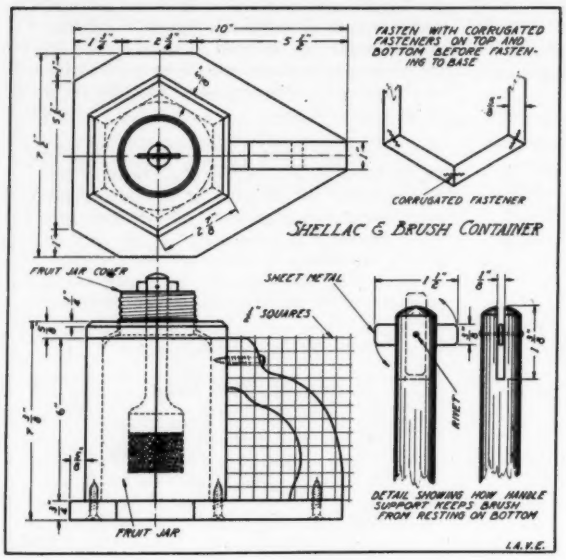


I.A.V.E.

SHELLAC AND BRUSH CONTAINER

Louis F. Barocci, High School, Cudahy, Wisconsin

This shellac and brush container has several features that make it a handy unit to have in the school shop. It provides for the suspension of the brush in the shellac, keeps the shellac and shellac brush together, thus avoiding the possibility of


FASTEN WITH CORRUGATED FASTENERS ON TOP AND BOTTOM BEFORE FASTENING TO BASE
CORRUGATED FASTENER
SHELLAC & BRUSH CONTAINER
FRUIT JAR COVER
SHEET METAL
1" SQUARES
RIVET
DETAIL SHOWING HOW HANDLE SUPPORT KEEPS BRUSH FROM RESTING ON BOTTOM
FRUIT JAR
I.A.V.E.

the students placing the shellac brush into the container for paint or varnish brushes, and provides a practically air-tight container for the shellac, thereby avoiding evaporation of the alcohol in the shellac. Keeping the shellac and brush together, renders the shellac ready for immediate use whenever needed. The quart jar holds sufficient shellac for several weeks' use in the school shop.

When a project is ready to be shellacked, unscrew cover, pivot brush support until it allows the brush handle to come through cover, and then the brush is free and ready for use.

SPIRAL SMOKING STAND

Lee H. Miner, Collinwood High School, Cleveland, Ohio

In schools where materials are low, most teachers are looking for projects that will embody much work and require little material. The project described herewith, admirably answers these requirements.

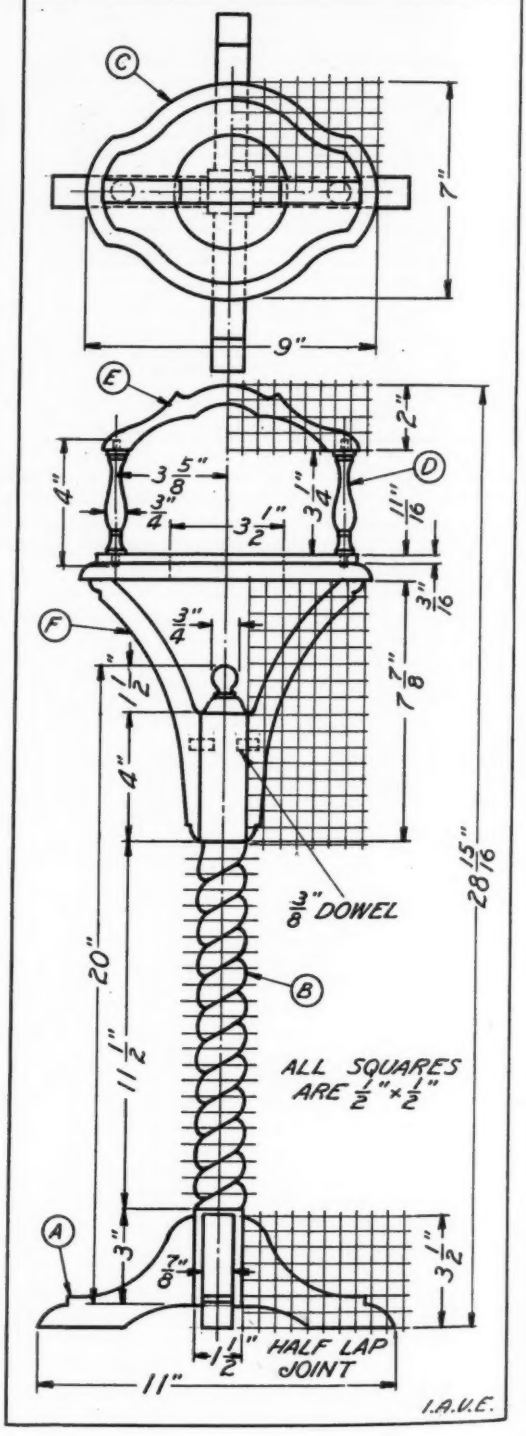
Directions

Feet: Square up a piece ⅞ by 2¼ by 21 in. Lay out the template of the foot from the drawing; this also will include the tenon which is 1¼ by ¾ by ½ in. with a ½-in. shoulder on each end. The 21-in. piece will just make four feet, if the pattern is reversed. The spokeshave and wood file may be used to smooth up the curves. After the base and upright have been squared to 90 deg., the tenon is laid out ¾ in. deep.

Post: Square up a piece 1½ by 1½ by 18⅜ in. long. Lay out the mortises for the feet on the lower square of the post, ½ in. from the bottom. The mortises should be ½ by 1½ in. and ¾ in. deep. Put the piece on the lathe leaving the squares at the top and bottom with a ¼-in. allowance for trimming down to the middle section. Turn the center portion down to the largest cylinder possible. The top design is then turned as shown in the illustration. If the dowels are used, they can be located and bored in the center on upper square of post to hold the brackets, but bradding and gluing may also be used and may be a little easier for adjusting the brackets in leveling the top. The spiral is then laid out on the middle section and cut out with bench saw and sharp chisel. A file is then used for obtaining the rounding rope effect of the spiral.

Top Brackets and Handle: By cutting out the templates for

BILL OF MATERIAL			
PART	REQ.	NAME	SIZE
A	4	FEET	⅞"×3½"×5¼"
B	1	POST	1½"×1½"×20"
C	1	TOP	1 1/16"×7"×9"
D	2	HANDLE POSTS	⅞"×⅞"×4"
E	1	HANDLE	¾"×2"×8½"
F	2	BRACKETS	¾"×3½"×7⅞"



all these and placing them with run of grain, the width and length of a piece of ¾-in. stock can be determined that will make all four pieces.

Top: If a shaper is in the shop, an edge can soon be put on the top to suit one's own taste. If necessary, a suitable edge can be put on with hand tools. The hole can be cut out to fit any tray desired.

Brackets: After cutting out the brackets, the part that is fastened to the post is planed square and tested with a framing square to see that both edges that fasten to the post and the top are at right angles and square with the face of the brackets. Holes 3/16 in. in diameter are drilled to receive 1-in. screws to fasten the brackets to the top. If dowels are used to fasten the brackets to the post, holes are bored to correspond to those on the post to receive the dowels.

Handle: After the handle is cut on a band saw or with a coping saw, locate holes on handle for posts and bore ¼-in. holes ⅜ in. deep.

Posts: These two posts could follow out the spiral effect of the post, but they may also be turned as shown in the illustration. The tenon at each end should be ¼ by ⅜ in.

Assembling: In putting the brackets on the post, great care must be taken to have the top level. In fastening the handle, posts, and top, glue is used. Care must be taken that all holes are bored straight and that tenons fit tightly. The feet are glued to the post as soon as a proper fit is obtained in the mortise-and-tenon joint.

Finish: Stain the project with a very thin coat of oiled walnut stain—no filler. Allow this to dry thoroughly, then rub white paint across the grain. Remove all excess paint. Allow this to dry and apply a coat of white shellac. After this has dried, rub it down with 2/0 steel wool, and then polish with pumice stone and linseed oil.

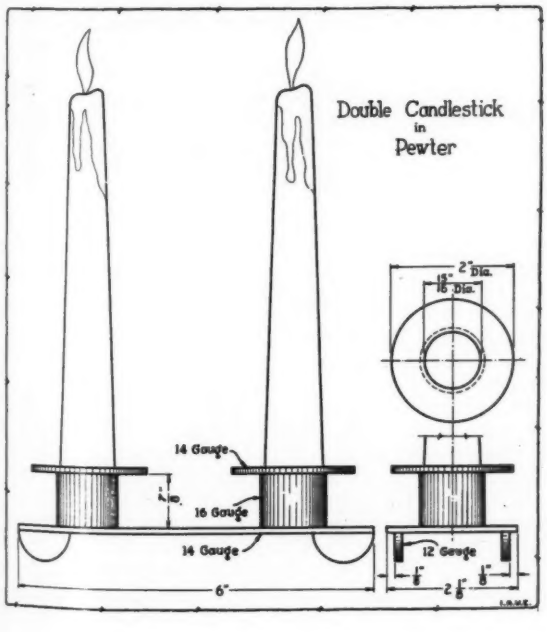
DOUBLE CANDLESTICK IN PEWTER

E. W. Manzer, Bronxville, New York

The double candlestick is a most interesting project. It is both useful and beautiful, and not too difficult for junior-high-school students. Care must be exercised in cutting the metal to the given dimensions, soldering the respective parts, and finishing the work. The following procedure will assist the boys and girls in making this project.

The Base

Cut two pieces of No. 14 B&S gauge pewter to the size given in the drawing. File the edges smooth with a fine file and finish with old emery cloth of very fine grit. For a better finish, buff the edges on a buff charged with tripoli. The surfaces of the base should be cleaned with old emery cloth, steel wool of 3/0 grade, and then buffed.



The Feet

Cut out with a jeweler's saw, two 1-in. circles of No. 12-gauge pewter. Finish the edges and then cut the circles in two equal parts, making four feet.

The Candle Holders

This calls for cylindrical forming. Turn out a wood mandrel on the lathe, 15/16 in. in diameter, and approximately 6 in. long. Cut a piece of 16-gauge pewter 1¼ in. wide, and long enough to wrap around the mandrel. The length of this piece may be obtained by trial and error, or by multiplying the diameter by 3.1416. When the proper length has been determined, cut 2 pieces of 16-gauge pewter to the determined length and 1¼ in. wide. Clean both sides with emery cloth and wrap each piece around the mandrel, making one cylinder at a time. A good tight fit on the mandrel is absolutely necessary for this job. File the edges smooth so that the joint fits closely. Wind iron binding wire (about No. 20) around each end of the four cylinders. This will close the joint and eliminate solder running to the outside of the cylinder. To solder the joint use pewter flux consisting of 1 ounce of glycerine to approximately 10 drops of hydrochloric (not muriatic) acid. This flux should be placed on the inside of the cylinder, after the latter has been hung on a ¼-in. rod so that the joint of the cylinder is down. Then play a small flame from a Bunsen burner on the underside of the hanging cylinder. When the flux boils, rub a finger (a piece of wire solder 4 or 5 in. long) of 70/30 solder (melting point 367 deg. F.) along the joint while the flame is being played on the cylinder. When the solder begins to melt, rub the finger of solder along the entire joint and remove the flame *immediately*. Add heat to the cylinder if the solder has not all melted. It is important that a small flame be used as too much heat will melt the pewter.

Next take the soldered cylinders, slip them, one at a time, on the mandrel, and place the mandrel on the lathe. Trim the ends of each cylinder with a chisel so that the resulting length of each will be ⅞ in. File the joint if necessary, using a smooth file, then finish with fine old emery cloth. Continue this operation until the joint is barely visible.

Disk for the Top of the Candle Holder

Take two circular disks of 14-gauge pewter 2 in. in diameter, or cut them out of flat stock. Cut a hole 15/16 in. out of the center of each with a jeweler's saw. File the edges smooth, and finish properly.

Soldering Disks to Cylinders

Place one of the disks on a piece of wood that has a perfectly flat surface. Place the cylinder on the disk. Flux the joint with pewter solder and solder with direct flame. Play the flame from a mouth blowpipe on the joint. When the flux boils, touch the joint with a finger of 65/35 solder (melting point 360 deg. F.). Do not blow too hard. If the air can be heard coming from the blowpipe, the flame will be too hot. A medium flame with some yellow will do the job perfectly. Finish the second candle holder in the same way.

Another method for this soldering is the indirect. Place a piece of sheet iron 3/32 by 5 by 7 in. on the top of a tripod, or bridging the tops of two bricks. An old cook-stove lid may also be used. Place the metal disk on this plate, set the cylinder in place, flux the joint and place small snippets of 65/35 solder around the joint or use the finger-of-solder method. The latter is the better method for soldering pewter projects. Next play a strong flame from a Bunsen burner under the plate, keeping the flame moving over the entire surface so that no "hot spot" is formed. Soon after the flux boils, the solder will melt. When this occurs, withdraw the flame *immediately* as there is enough residual heat in the plate to melt the solder completely. Wash off all the flux with water.

Next place each candle holder on the mandrel and clean it with fine emery cloth or fine 3/0 steel wool. With the candle

holders still on the mandrel, polish them on a tripoli buff. Remove all excess tripoli and then buff on a rouge buff. Remove all excess rouge and wipe with soft rag. This will produce a high polish that will equal any commercial job.

Soldering Candle Holders to the Base

Use the direct or the indirect soldering method for this operation. Place the base on the plate, set the holders in their proper places, flux the joint on the inside, place solder snippets 65/35 *inside the cylinders* and heat until the solder melts. If direct soldering is done, place the snippets on the outside of the joint, or use the solder finger.

Soldering Feet to Base

Turn the candlestick upside down and spot the feet in their respective places. Flux the joint and cut and place small snippets of 65/35 solder on the inside of each foot. Use the direct soldering method, blowing the flame of a mouth blowpipe on the base around the foot. This is to preheat the large base, then gradually bring the flame up to the foot and heat the joint until the solder melts.

Finishing the Candlestick

Remove all traces of the flux with water. Buff carefully on a tripoli buff and then clean off all surplus tripoli that clings to the metal. Now buff on a rouge buff for a high polish. Then clean off all rouge with a clean soft rag and the job is ready for a set of tall candles of a pastel color.

Do not put strong colors in pewter articles. The softness of the patina of pewter calls for subdued colors.

"HELPS" FOR THE WOODSHOP TEACHER

Oliver W. Barrick, Lancaster, Pennsylvania

Much has been said about the value of enlarging the scope of shopwork, adding new processes, and getting better results. Little has been said, however, of how this may be accomplished. That is the definite purpose of this article.

In the first place, a boy must thoroughly understand the construction of the article he intends to make. Even though blue prints are available, the importance of making clear the constructional details must not be forgotten.

It is well for the instructor to collect catalogs and magazines, out of which pictures of many articles may be cut. These should be mounted on stiff paper or cardboard and grouped according to the difficulty of their construction and according to the particular classes for which they are suitable.

At the beginning of the semester it is well for the instructor to explain the various joints that will be needed. The general construction of tables, desks, chairs, stools, and other articles should be shown. Then the student can be allowed to look over the pictures and select the project he wishes to make, or he may suggest one which he has obtained from some other source.

In addition to the usual instruction on use and care of machinery, safety first, care of tools, etc., the students must be shown how to make out a bill of material. With the project chosen, each boy then makes out a bill of material for the job which he has selected, and this, together with a sketch of the project, is then handed to the teacher.

This enables the instructor to check on the boy's work and see that he knows what he is doing. It also gives the boy an approximate idea of the cost of the job he has chosen.

In order to assist the more able students, the following suggestions for advanced work are listed. They may all be embodied in the work at once, but it is better to add one or two new processes every term.

Edge Inlay: This is an easy way of adding to the appearance of an otherwise simple project. It is done by taking a rabbet cut on both edges and ends, and fitting in strips of another kind of wood. The rabbet cut may be made on the ripsaw, or with a hand router and a back saw. Care should be taken to have all joints tight, as shown in Figures 1 and 2.

If the inlay strips are not long enough for full-length pieces, the joint should be made in the middle, as in Figure 2 at "M." If good wood glue is used and the strip is held in place for a few seconds, no clamps should be necessary.

Strip Glue-Up: This operation is generally used in making a checkerboard. Four strips are prepared of each of two different kinds of wood, and a simple glue-up made, alternating the woods as shown in Figure 3. For most work, strips 1½ by 14 in. are suitable. After the glue is dry the piece should be squared up, then crosscut to make eight strips 1½ in. wide. A planer saw will give a smooth cut. Now every second one should be turned end about, and the whole glued together again as in Figure 4. If desired, the board may be enlarged as well as strengthened by putting a simple frame around it, or a more fancy frame may be used, as in Figure 5.

Strip Overlay: Gluing strip overlays to a small table, piano bench, or any flat-top project is very easy, yet it looks like a great improvement over the one-piece top. The important thing in making a good job of this type project is to rip all the strips exactly the same width. The design should be regular, and all joints tight. Also the arrangement of the various kinds of wood should be orderly. (See Figure 6.)

Simple Padded Seats: These are a big improvement over

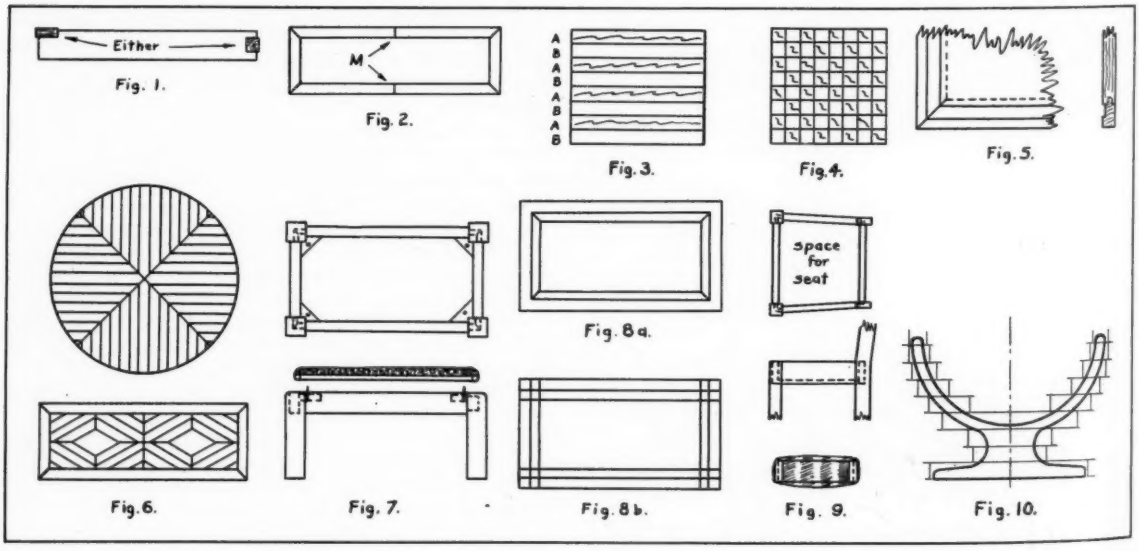


Fig. 1. Fig. 2. Fig. 3. Fig. 4. Fig. 5.

Fig. 6. Fig. 7. Fig. 8a. Fig. 8b. Fig. 9. Fig. 10.

the solid type. (See Figure 7.) The body of the top piece need not be new wood. Pieces from a packing box are satisfactory. After the top is cut to the proper size, padding of either cotton or haircloth should be cut to size and tacked to the top to prevent slipping. The covering should be stretched over this. It should be folded carefully at the corners, and tacked securely to the bottom. The seat is then ready to be attached to the frame. This may be done by inserting screws through the corner braces into the seat.

Border Inlay: The border inlay is perhaps the most simple type of real inlay. It may be cut with a hand router and chisel, or with an electric router, if the type shown in Figure 8*a* is used. The type shown in Figure 8*b* may be cut on a circular saw.

Letter Inlay: The process of inlaying letters should first be attempted by using simple block letters. The sides of the inlay space should be cut square with the surface, and straight. The strip to be inserted must fill up the entire slot of each letter. In fitting one strip to another, the joints should be as tight as they are along the sides.

Upholstered Seats: The construction of simple upholstered seats greatly enhances many projects. A chair or stool that is to be made with such a seat should be constructed with an open seat frame as shown in Figure 9. Across the bottom of the seat, frame support pieces should be fastened.

For the upholstered seat then, a frame must be made which will fit in the space left for it. This frame must have a little clearance, but should not be loose. It should be braced solidly on the inside with small glued-in corner blocks, so that it will hold its shape.

Strips of webbing should then be tacked securely over one side of the frame. Used automobile seat or back springs, or springs specially bought for the job, must then be firmly tied to the webbing. The webbing should then be stretched and tacked over the other side of the seat, and the springs tied here also.

A layer of padding should be put on each side before the final covering is tacked on. The seat should be covered all around the edges, as well as both sides, thus making it reversible.

Upholstered Seats and Backs: In many cases the upholstery is fastened directly to the chair seat or back, instead of to a movable frame. In upholstery of this type, care must be taken to fold and tack the cloth at the corners very carefully to avoid bulkiness.

Much help may be obtained in the details of this work from catalogs of upholstered chairs and davenports in which special methods of construction are described and illustrated.

Spiral Cutting: This process is not practiced much in schools, but it makes a splendid simple carving project. Instead of describing it here, the reader is referred to the article in THE INDUSTRIAL ARTS AND VOCATIONAL EDUCATION MAGAZINE, issue of January, 1934, on page 8, in which the process is described completely.

Such spiral coverings may be used as a center post for smoking stands, pedestals, coffee tables, end tables, console tables, and the like.

Segment Turning: The average school shop does very little segment work. Perhaps if the fundamental operations were better understood, fancy segment turning would be more popular.

To obtain best results, the student should make a full-sized layout of the job he intends to make, say, a fancy fruit bowl, as in Figure 10. An accurate vertical center line is necessary; lines should also be gauged parallel with the base, representing the thickness of the lumber to be used.

Each row of segments should be cut so there will be about one-eighth inch of material to turn off at the lowest part. The layout may be used to show the inside and the outside diameter of every course of segments. The first row should be placed accurately on the base, and each consecutive row should be built up as nearly central as possible. The base may be made up of four or six sector-shaped pieces instead of a solid, if desired.

An attractive article will result if each course or row is made up of a different kind of wood. It also is possible to use different kinds of wood in the same course, but they should be carefully arranged as to color, in order to look well.

Every joint must be tight, otherwise openings will show on the finished product. It is best to glue up two or three courses and let them dry. Then turn the face true, and mark off a true diameter on which to continue the gluing process.

Fancy Overlay: This is the most difficult type of overlay project, as it consists of a fancy design, built up on a job. A design may be drawn or selected from a catalog.

Best results will be obtained if the wood combinations and the design are carefully studied. Many kinds of wood are suitable, but usually one kind seems to fit one design better than others.

These designs may be glued directly on the project, or they may be glued together first, then glued in place. In either case, the joints should be well made.

Fancy Inlay: This type of inlay is difficult to apply but wonderful results can be achieved with it.

Careful selection of wood is urged. When cutting out the design for the inlay, care should be taken to cut to the line, but not beyond it.

No piece is ready to be glued in until it fits the others on all sides. The more difficult the design, the greater will be the satisfaction with the final result.

BENCH PUNCH

Carl E. Janson, William B. Rogers Intermediate School, Boston, Roxbury, Massachusetts

The bench punch shown herewith was designed for use in machine and sheet-metal shops. It may be made in the machine shop of the junior high school.

The machine work practically covers the use of all the machines and there is an abundance of related-subjects material that may be taught in connection with the work. The patterns may be made in the pattern shop of the school, and the castings may be obtained from a foundry near by if the school industrial-arts courses do not include a foundry course.

The directions for machining are given in a general way.

Body of the Punch **(1)**

Plane the bottom; mill or plane for die holder and caps; drill and tap holes for cap screws; fasten caps in place; drill or bore holes for plunger, eccentric shaft, straps, die plate.

Special tools needed are (*a*) boring bar for plunger, (*b*) drill for stripper, and (*c*) counterbore for finishing the surface for die plate.

The Caps **(2)**

Mill or plane face; drill holes, assemble and bore with body.

Eccentric Strap **(3)**

Mill the ends, drill and tap; fasten caps (4) and (5) and then drill the 5/16-in. hole and finally the 3/4-in. hole.

It may be desirable to make two fixtures for this job; the first one for holding while milling the angle, and the second one for drilling the 3/4-in. hole. This latter fixture may consist of a 5/16-in. pin, 2 5/16 in. long placed vertically in a plate. A drill jig or a drill bushing or guide 4 5/8 in. from the pin may then be used for drilling the 3/4-in. hole.

Eccentric Shaft **(6)**

Center, square ends, lay out centers for eccentric, turn up the various diameters, mill the keyway.

Plunger **(7)**

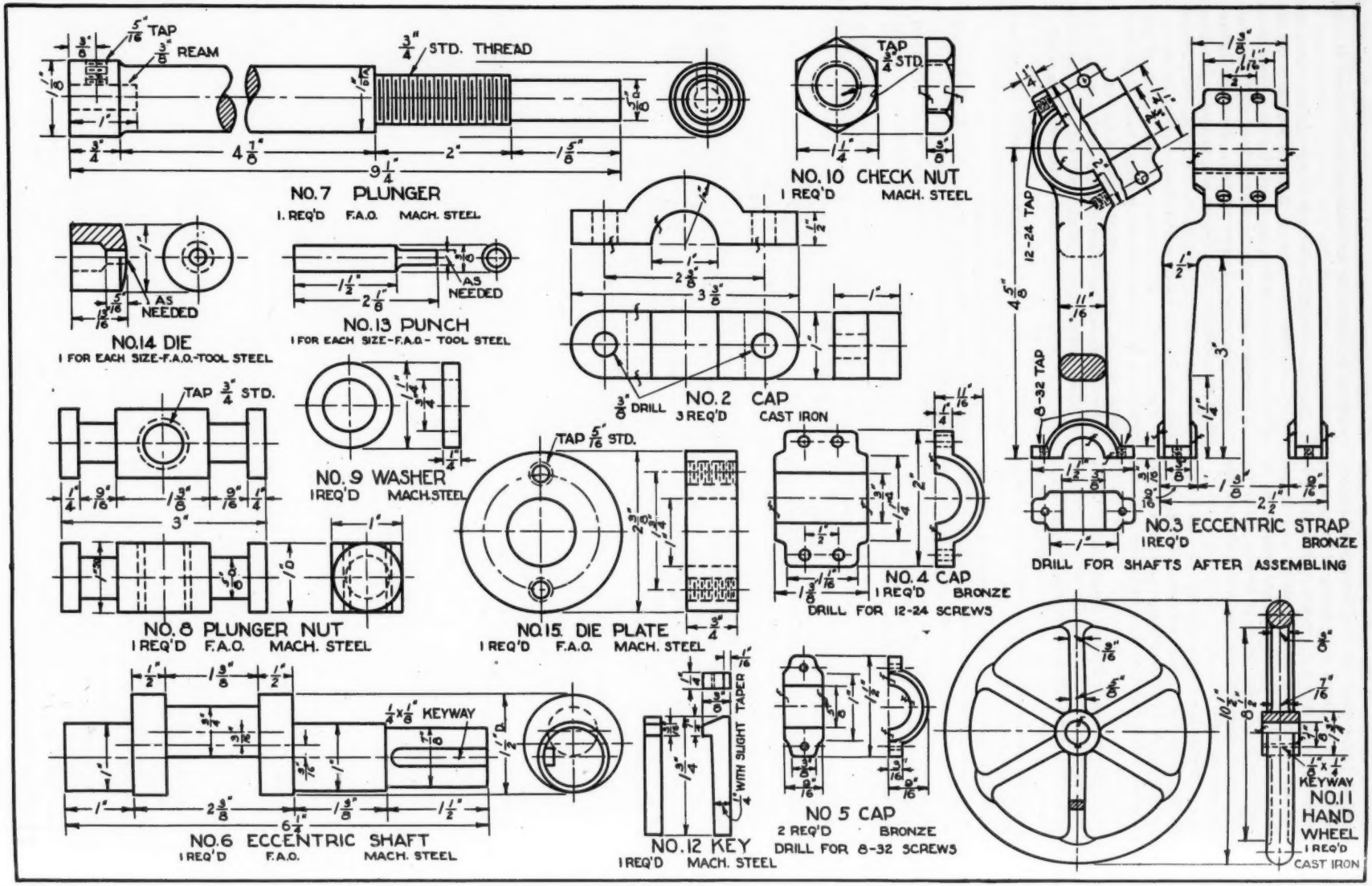
Center, square ends, drill and ream the 3/8-in. hole, making false center plug for this hole, finish turning and threading, and tap hole for the setscrew.

Plunger Nut **(8)**

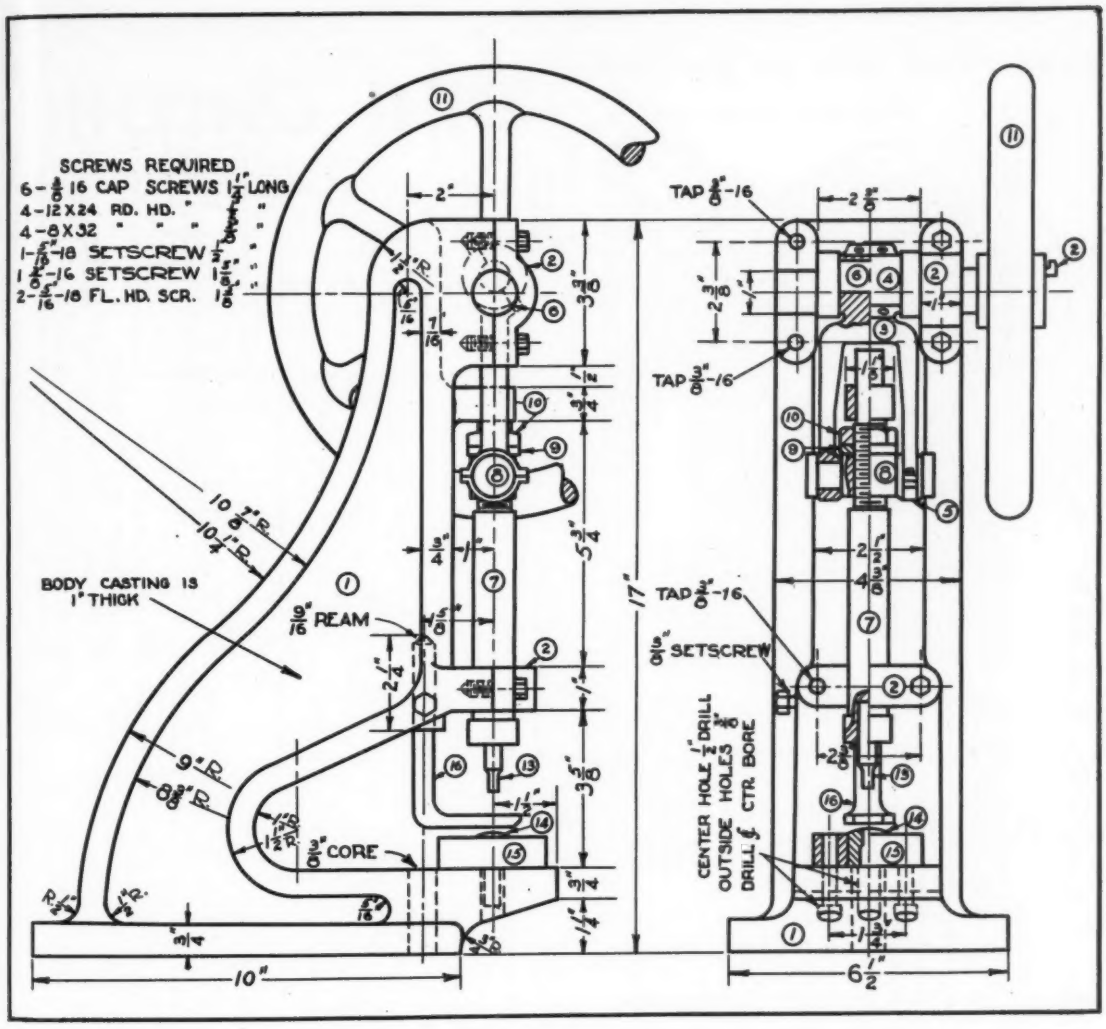
This may be made from a piece of 1-in. square bar. Center and square ends, turn the 5/8-in. and 1-in. diameters, drill and tap.

The Washer **(9)** ***The Check Nut*** **(10)** ***The Hand Wheel*** **(11)**

These need no further explanation.



Bench punch details



Bench Punch Assembly

Key (12)

This is ¼ by ⅜-in. steel and may be filed or machined to shape.

Punch (13) *Die* (14)

These may be made in sizes to suit the requirements, ranging from 1/16 in. to 5/16 in. in diameter. They must be hardened and tempered.

Die Plate (15)

This needs no explanation.

Stripper (16)

This may be made from a piece of 9/16-in. round steel with end flattened and drilled so that the punch may go through easily.

Related Subjects

The mathematics on this job covers common fractions, decimals, simple equations, percentage, ratio and proportion, square root, and short cuts of the trade. To cover the foregoing subjects it is necessary only to check up the dimensions, estimate the proper feeds and speeds, determine the gear changes needed for thread cutting, figure out the sizes of drills needed for tapping holes, calculate the strength of material, or the weight of material, estimate costs, and learn how to use formulas.

English. Written and oral lessons on work performed in the shop, describing details, processes and complete jobs, or describe what was seen on visits to shops. Write letters to pattern department, to foundry, and to the sheet-metal shops.

Geography. Source of iron ore and copper, location of steel plants, steamship and railroad routes, compare (iron and copper) exports and imports of this country with that of others.

History. The relations of allied trades as connected with this job, such as (*a*) pattern shop, (*b*) iron foundry, (*c*) brass foundry, (*d*) machine shop, (*e*) sheet-metal shop. Discuss hours and wages, various ways of entry into the metal trades, and the lines of promotion in each. A trip into shops of various kinds will give the boy a wonderful idea of the trade. The foundry seems to be of especial interest to the pupil.

Science. Elementary mechanics involving law of the lever, axle, inclined plane, and screw.

Elementary metallurgy, properties and composition, strength of material, selection of material for various parts.

Heat treatment, hardening and tempering.

Study of the punch as a combination of mechanisms each doing a different kind of work, but the whole combination working together accomplishing some desired result.

Safety Rules. Last but not least, a study as to safe operation of the machines, shifting of belts, and the proper use and care of tools.

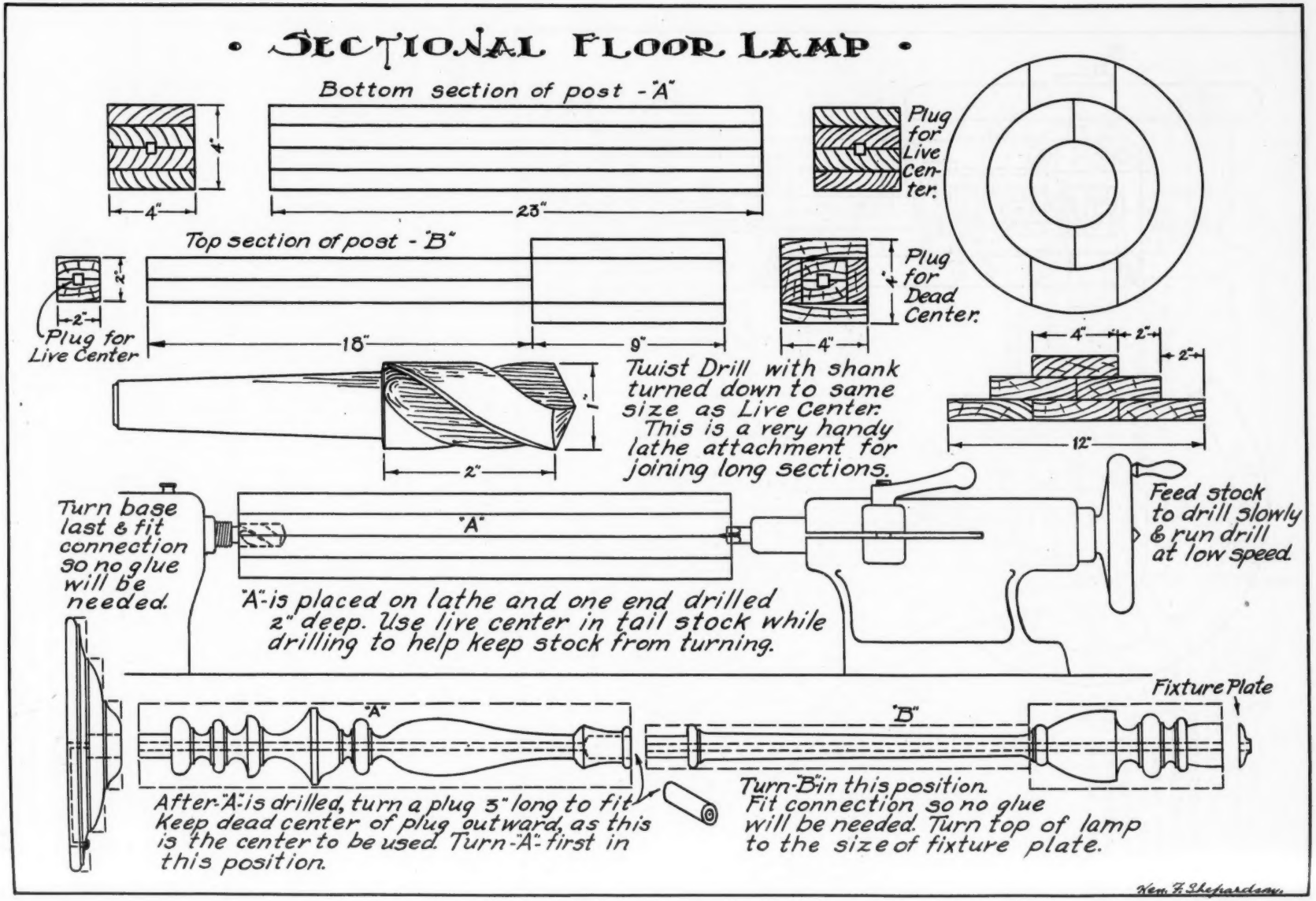
SECTIONAL FLOOR LAMP

Kenneth F. Shepardson, La Crosse, Wisconsin

Floor lamps continue to be a popular wood-turning problem, and if made in several sections are not difficult to turn. A good feature of a sectional floor lamp is that it is portable

(Continued on page 6A)

• SECTIONAL FLOOR LAMP •


Bottom section of post - "A"
4"
4"
23"
Plug for Live Center.
Top section of post - "B"
2"
2"
Plug for Live Center
18"
9"
Plug for Dead Center.
4"
4"
2"
2"
12"
Twist Drill with shank turned down to same size as Live Center. This is a very handy lathe attachment for joining long sections.
2"
Turn base last & fit connection so no glue will be needed.
"A"
Feed stock to drill slowly & run drill at low speed.
"A" is placed on lathe and one end drilled 2" deep. Use live center in tail stock while drilling to help keep stock from turning.
Fixture Plate
"A"
"B"
After "A" is drilled, turn a plug 3" long to fit Keep dead center of plug outward, as this is the center to be used. Turn "A" first in this position.
Turn "B" in this position. Fit connection so no glue will be needed. Turn top of lamp to the size of fixture plate.
Ken F. Shepardson.

(The article on the sectional floor lamp is continued on page 6A)

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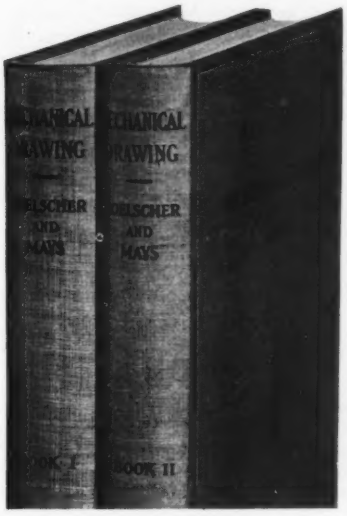

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(Continued from page 303)

without the use of a clumsy crate if the sections are not joined with glue.

This lamp is made of stock 4 in. wide and 1 in. thick. Considerable stock is saved in this manner and the glue joints are more likely to stick even though the wood may not have been properly dried.

After the stock has been glued up, plug one end of A and both ends of B. The unplugged end of A is drilled as shown in the drawing. The drill will follow the hole made for the cord. Drilling in this manner, the hole will be absolutely centered.

Next, turn a plug 3 in. long, to a press fit, for the hole just drilled in A. Insert the live-center end of the plug in the drilled hole and turn up section A.

Next, turn B down to the largest possible round and turn the small end to fit the drilled hole in A. (Be sure to make a tight press fit as these parts are not to be glued.) Turn the large end of B to fit the fixture plate to be used and then turn up the rest of B.

Next, turn out the base of the lamp, and make the hole in the base a trifle smaller than the part of A which fits in the hole. Put A back on the lathe and turn the spindle down to fit the hole in the base. (It is easier to turn a spindle to fit a hole than vice versa.)

A lamp turned out in this order is more likely to be better proportioned than if turned otherwise.

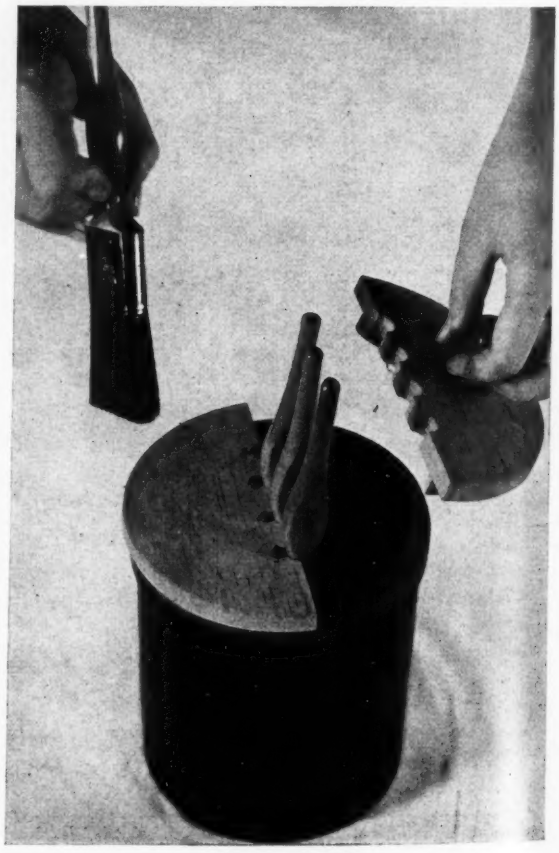
A BRUSH KEEPER

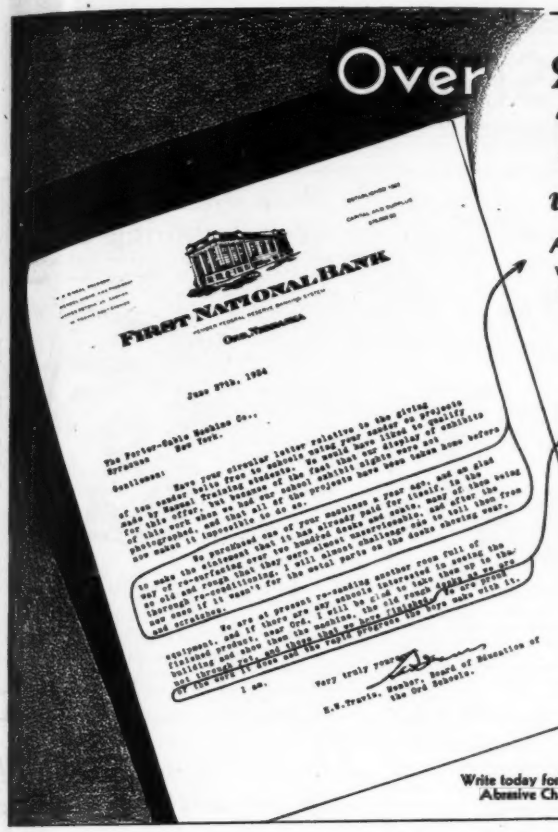
E. G. Livingston, Iowa State College, Ames, Iowa

The problem of adequately caring for wood-finishing brushes that are used frequently enough to make washing them out impracticable, is a perplexing one. It is faced by the teacher, the painter, and the home-workshop devotee.

The accompanying photograph pictures a method devised by the writer for keeping shellac brushes. The picture shows clearly the construction and use of the device.

(Continued on page 7A)





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(Continued from page 6A)

The intention was to place thin shellec in the jar in which to suspend the bristles, but the lid is so air-tight that brushes used in shellac have been kept without hardening for three days without a keeping solution.

The idea may be adapted to jars or cans of various sizes and shapes. A three-cell glass battery container would make a splendid brush safe.

Some Questions Answered

FINISHING BASEBALL BATS

993. Q.: Please give a finish for ash and hickory bats. — *A.A.K.*

A.: You will find that the shellac-mixing lacquer mentioned in *Principles of Mill and Paint Shop Practice* will serve to produce a fine finish on your bats. On the other hand, perhaps some of the methods which I have installed with production plants may be of value. After the bat has been turned and is still in the lathe, coat with filler rubbed in while bat is turning at 600 r.p.m. This is best done by means of a heavy strip of cloth held stretched in both hands so that the center portion bears down on the work. Allow to dry overnight, and then varnish with a single coat of dull or gloss, four-hour varnish, the latter being given 24 hours hard drying in a warm room.

Another treatment calls for the use of colored fillers, followed by varnishes. Again, a large Bunsen burner with an oxidizing flame tip may be used to burn the bat in flashed areas to give a light decorative treatment. It should then be sanded with 6/0 paper and then filled and varnished. On some woods, a coat of varnish having about an ounce of medium chrome yellow or similar japan ground color added to a gallon of clear varnish, adds considerable "snap" to the general tone of the finish. These suggestions and some experimenting on your part should lead to good results. — *Ralph G. Waring.*

Personal News

¶ Dr. Robert L. Cooley, director of the Milwaukee Vocational School, Milwaukee, Wis., was recently honored by the Cosmopolitan Club which designated him as the city's most distinguished citizen for 1933. The club presented Dr. Cooley with a gold medal at a dinner given in the City Club. This dinner was attended by leading educational and civic workers. The award was given to Dr. Cooley for "self-sacrificing service to the community beyond the call of duty."

¶ Supt. Frederick J. Moffitt, of Hamburg, N. Y., was given the degree of doctor of letters, *honoris causa*, by Hobart College, at the June commencement of the college. Dr. Moffitt is a graduate of Hobart College in the class of 1918 and has completed postgraduate work at Syracuse University, Buffalo State Teachers' College, and Buffalo University.

¶ Mr. Leroy W. Hostettler, formerly of Durham, N. C., has gone to Bessemer, Pa., where he has taken over the work of instructor in woodwork, mechanical drawing, and vocational guidance in the high school. Mr. Hostettler attended The Stout Institute, Menomonie, Wis., and holds the degree of B.S. in industrial education.

SchoolShopEquipmentNews

NEW TOOLROOM GRINDER

The Stanley Electric Tool Company, New Britain, Conn., has announced its new toolroom grinder No. 585, a new tool having innumerable uses.

This grinder may be mounted on a lathe, miller, or shaper, or on a special bench stand, has a variety of abrasive wheels which may be used to grind the openings in all kinds of disks and jigs. It also may be used to grind keyways and slots, and for other

(Continued on page 9A)

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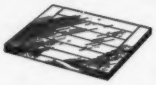

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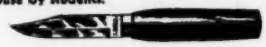

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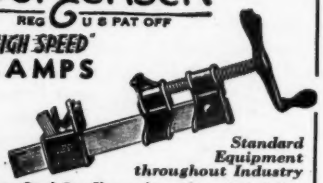

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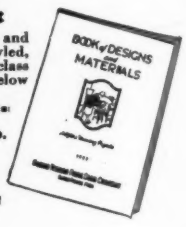

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A Manual Training Bench that stands the test of time

Details on request

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(Continued from page 7A)

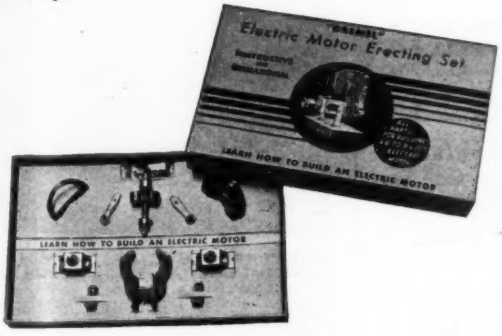
internal and external grinding operations. As a hand tool, it may be used to do rough-off hand grinding on castings and forgings. With a metal-cutting bit, it may be used to machine aluminum patterns, brass templates, and parts made of other nonferrous metals.

Stanley toolroom grinder

The toolroom grinder is equipped with a 3/8-h.p. universal motor. This is sufficiently powerful to drive a 1½ by ½-in. wheel, and perform a real grinding job. Complete information may be obtained by any shop instructor upon request.

Electric Motor Kit

The Dremel Manufacturing Company, Dept. 509, Racine, Wis., are marketing an inexpensive, high-grade electric motor kit for the school shop.



Electric motor kit

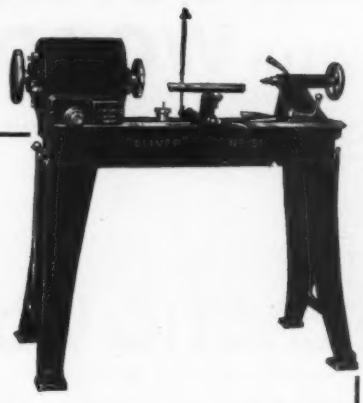
Complete instructions accompany each kit, and all the required parts for the assembly of the motor, including the motor pulley, are furnished. The elementary principles of the motor become much clearer to the student after he has assembled a motor of this kind. The motors may be operated with 4- to 8-volt batteries or from transformers, and they may be used for fans, erector sets, and for other purposes requiring small power motors.

NEW STANDARD ELECTRICAL TOOL CATALOG

The Standard Electrical Tool Company, 1938 West Eighth St., Cincinnati, Ohio, has announced its new Catalog No. 37, which lists the complete line of electrical drills, grinders, buffing and polishing machines manufactured by that company.

A copy of the catalog will be sent on request.

High Grade Machinery



Write for descriptive circular on this machine

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Other "Oliver" machines adapted to your needs include: Boring Machines, Band Saws, Mortisers, Sanders, Saw Benches, Surfacers, Planers, Tool Grinders, Vises and Wood Trimmers.

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The School Shop Shopping Guide

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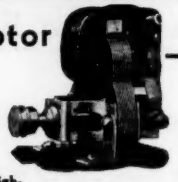

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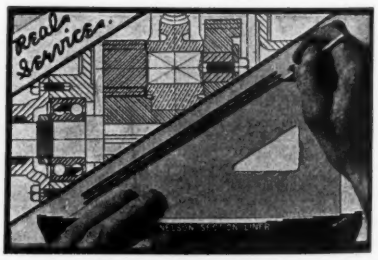

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